The American

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(ILLUSTRATED.)

DEVOTED TO THE INTERESTS OF

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—AND—

GENERAL SCIENCE.

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[OFFICIAL NOTICE.]

Fifth Annual Meeting, Pacific Coast Gas Association.

PACIFIC COAST GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
OAKLAND, CAL., June 4th, 1897.

The fifth annual meeting of the Pacific Coast Gas Association will be held at San Francisco, Tuesday and Wednesday, July 20th and 21st, 1897, at 10 o'clock, A.M., in the office building of the San Francisco Gas and Electric Company.

A meeting of the Board of Directors will be held on Monday, July 19th, at 8 P.M., at headquarters in same building.

The following papers will be read and discussed during the sessions:

The President's Address, by Mr. T. R. Parker, Napa, Cal.

"Spontaneous Ignition of Coal," by Mr. John L. Howard, San Francisco.

"Reminiscences," by Mr. F. H. Eichbaum, San Francisco.

"Value of Small Gas Bills," by Mr. W. W. Gillespie, San Francisco.

"From Coal Gas to Natural Gas," by Mr. John Kempf, Jr., Salt Lake City, Utah.

"Small Lighting Plants and their Management," by Mr. Thos. D. Petch, Eureka, Cal.

"Practical Suggestions," by Mr. Chas. E. Burrows, Walla Walla, Wash.

"Uniformity of Accounts," by Mr. C. O. G. Miller, San Francisco.

"Municipal Control," by Mr. C. W. Quilty, San Jose.

"A Short History of a Long Life," by Mr. C. M. Converse, San Francisco.

"Recuperative Benches for Coke and Coal Firing," by Mr. D. R. Russell, St. Louis, Mo.

"Card Bookkeeping," by Mr. V. Stow, San Francisco.

"Gas as Fuel," by Mr. F. Foveaux, San Francisco.

Questions received will be assigned to members for reply.

The "Experience" Department, edited by Mr. John Clement, of Red Bluff, Cal., and the "Wrinkle" Department, edited by Mr. M. C. Osborn, of San Diego, Cal., will make report.

All gas men sojourning in San Francisco at the time of the meeting are cordially invited to be present and to participate in discussions. The Secretary will at all times cheerfully answer any questions and furnish information concerning the meeting, hotel accommodations, etc.

Thursday, July 22d, 1897, will be the outing day for members, their families and friends. A trip on the world-famed scenic railway to the top of Mount Tamalpais will be made, and luncheon served at the "Tavern of Tamalpais." From San Francisco to the mountain top there is revealed the grandest panorama of ocean, cities, towns, bays, valleys and mountains in the world, the view reaching from the snow-capped Sierras to 60 miles from the Marin county shores on the Pacific. The usual banquet will be held on Tuesday evening, July 20th.

Eastern members, and others from the Eastern States intending to visit San Francisco, are requested to advise the Secretary in advance.

JOHN A. BRITTON, Secretary.

BRIEFLY TOLD.

THE STATE OF TRADE.—The first half of 1897 is ended, and it is with no little degree of satisfaction that we report a vastly better condition of affairs existing in the gas trade than was the case for the first half of 1896. The current indications in almost all classes of business are favorable to renewed activity and a widening or broader market, the trading wherein is to be done at figures representative of a living profit; and the underlying influence is that of returning confidence. The first months of the year in the gas trade were marked by peculiarly uneven conditions; indeed, the symptoms might be truthfully set down as curiously uneven. Similar places, that is as to the matters of population and the nature of the commercial and social features of the communities compared, reported entirely dissimilar results, in that one place would show a gain in sendout, whereas the comparing place showed a loss. In March the figures received by us tended to prove that a return to normal standing was being steadily made, and this approach to normalization was still more clearly revealed in the returns for April. The statistics for May and the first half of June sustain and correspond with those of March and April, wherefore it can be taken for granted that the advances registered are testimonies to steady betterment, and are entirely free from spasmodic taint. The statements of output from 53 test points, representing a total sale for the first five months of 1897 of 8,500 millions cubic feet of gas, show a gain for the period named over the corresponding period of 1896 corresponding to 6.8 per cent. Of the 53 reporting companies, 22 state that important main extensions are underway, and 13 report other considerable betterments to the manufacturing and storage sections of the plant. The backwardness of the season—that is, the long delayed appearance of the heated term—seems to have interfered considerably with the putting out of gas cookers, but on the other hand the prevalence of dark, cool days seems to have more than made up the difference. Companies to the number of 17 report the holding of demonstration lectures on cooking by gas, which in every instance fully realized the expectations of those who engineered them. Take it all-in-all, the figures are rich in their teaching that a long season of prosperity is before the gas makers.

THE THIRTY-FOURTH GENERAL MEETING OF THE INCORPORATED GAS INSTITUTE.—The Thirty-fourth Annual General Meeting of the Incorporated Gas Institute was successfully brought off at Bath, England, on the 15th, 16th and 17th of last month, under the able guidance of Mr. C. Stafford Ellery, of the Bath Gas Company. Fair skies, a good paper list and many handsomely planned and fraternally carried out social features caused the meeting to be thoroughly enjoyed. The additions to the membership were quite numerous, and one name on the list was that of Mr. A. B. Slater, Jr., of Providence, R. I. The Institute awarded the Birmingham Medal to Dr. Carl Auer von Welsbach for his discoveries and inventions connected with incandescent gas lighting. A feature of the proceedings was the lecture, on the morning of the second day, by Vivian B. Lewes, F.I.C., whose theme was: "The Theory of the Atmospheric Burner and Its Influence Upon Incandescent Gas Lighting."

NOTES.—We presume that the parties in control of the Companies that formerly composed what was popularly known as the Chicago Gas Trust, now that, under the laws passed at the last session of the Illinois Legislature, legal consolidation of the different interests can be made, have virtually agreed on a plan for such consolidation. The gas situation in Chicago, however, has altered considerably since the spring of 1887, when the Trust was originally formed, for several new independent Companies have been equipped since then, and it seems to us that they are of enough importance to be included in any scheme of consolidating the gas business of Chicago. To sum it up in a few words, it seems to us that any scheme for consolidating the gas interests of Chicago, that did not include every Gas Company in Cook county, would be decidedly imperfect.——The water gas apparatus at the Pullman (Ills.) gas works, built by Messrs. A. O. Granger & Co., in 1882, after having faithfully and well performed its duties, has at last succumbed to the march of progress, the United Gas Improvement Company having been awarded a contract to install at Pullman a standard double superheater Lowe water gas plant, of 400,000 cubic feet daily capacity, with all up to-date improvements. The contract also includes steam plant, purifiers, station meter, rotary exhauster, oil storage tanks, new buildings, etc. The relief holder system will also be applied to the works —— Mr. Charles E. Dole has been appointed Superintendent of the Bangor (Me.) Gas Light Company, succeeding the late Mr. A. H. Parker. Mr. Burnham K. Gould was appointed Assistant Manager.——We understand that the Pacific Lighting Company has sold its ownership in the Santa Rosa (Cal.) Gas and Electric Light Company to Mr. Philip Meyer, of Alameda, who assumed charge on the 1st inst. Mr. Thos. D. Petch resigned the Superintendency of the Eureka (Cal.) Gas Company, to accept the Superintendency of the Santa Rosa plant.

[Prepared for the JOURNAL.]

Some Notes on an English Oil Gas Process.

By Mr. F. EGNER, of Norfolk, Va.

One of the objects of interest, seen by the author during a recent trip to Europe, was a novel oil gas process, now for some years in successful operation, on a large working scale, at the Corporation Gas Works, Huddersfield, England. The results were so much better than those known to be obtained at some so-called "Pintsch works" in this country, that a description of Mr. R. W. Herring's[1] method (for it was learned that he was the inventor) may prove useful to the reader. In explaining his method the inventor said: "My invention is based on the fact that the degree of heat suitable for the operation depends upon the specific gravity of the oil, *and that the specific gravity of the oil increases as the distillation progresses*, so that the heat which is suitable at the commencement of the distillation is insufficient for the continuance of the distillation through its subsequent stages. The invention consists in an apparatus for effecting a methodical and systematic subjection of the liquid hydrocarbon to a progressively increasing heat as it flows through the retort or series of retorts, so that as the specific gravity of the oil increases so will the temperature at which the distillation is continued and completed."

If the inventor's theory appeals to the scientific common sense of the gas engineer, the simplicity of the apparatus and its whole operation will do no less to that of the experienced, practical gas maker. Although it is no doubt best to proportion the length of the oven to be used for the oil gas retorts to the general design of the same, any through retort arch can be used for the purpose. There is no special construction required; the necessary objects can be obtained by the manner of filling-in the bench.

The benches seen in use were heated by a regenerator or gas furnace. There were three tiers of cast iron retorts in the bench, the lower tier, of larger diameter than the two upper tiers, being protected from direct contact with the fire by brick walls, which served the double purpose of protection (as stated) and of assisting in maintaining a more uniform heat, because the brick, after absorbing, retains heat longer than the iron will. These lower retorts were set with a slight incline towards the front of the bench. Between the lower and the two upper tiers of retorts was a brick arch, pierced (at the ends only) for the furnace gases to ascend, and these openings were controlled by suitable damper tiles. The upper retorts were set with a slight incline towards the back of the bench, and the combustion chamber in which they were placed was divided into several sections, by means of vertical baffle walls resting on the arch covering the lower combustion chamber and retorts, and reaching to the top of the principal oven orch. These baffle walls had openings alternately at top and bottom to allow passage of the gases of combustion to the chimney flue. But a novel feature of these several chambers, formed as described by the baffle walls, was that each was furnished with a damper controlled opening from the outside of the ovens, so that cold air could be admitted wherever desired, thereby the better to regulate the temperature desired in these progressive chambers. Each of the lower retorts had an ascension pipe to carry the gas produced into a condensing main, into which the upper retorts also discharged the gas made therein. The object of the condensing main is to permit any hydrocarbon which was not fixed in the retorts to run back to the lower retorts and undergo another season of heat. The unconverted oil from the upper retorts was caused to flow out of the back and lower ends of same into a small hydraulic main like chamber, from which it then ran into the higher end of the lower retorts, from which latter the final residual was removed from time to time in the shape of coke.

The action of the upper retorts was continuous, that of the lower being intermittent; this necessarily so in order that the accumulations of coke might be removed. Hence a valve was placed in each of the ascension pipes from the lower retorts to the condensing main. The oil was admitted through sight glasses at the front and high ends of the upper retorts. Each tier of these upper retorts was connected at the mouthpiece with a horizontal take-off pipe to which all on that tier were attached, and from which one ascension pipe carried the gas made to the condensing main.

These stand pipes were also provided with a valve, so that any battery or tier of retorts could be cut out without interfering with the remaining retorts of that bench. It was found in practice that with the means provided the heat at various points in the retorts could be perfectly

1. Mr. Herring is now the Chief Engineer and Manager of the combined Edinburgh and Leith Corporation Gas Works, Scotland.

regulated. As, for instance, when at the point of admission of the oil the retort temperature was from 400° to 500° F., it could be increased to 600° a little further on; then to 700°, 800°, 900°, and so on, until at the lowest point of the bottom retorts it would be from 1,600° to 1,700°. At that point nothing would be found in the retorts but solid coke; and not more than one-fifth as much of that than when the same kind of oil was operated upon by the best known methods of other systems of carbonization.

The oil used by Mr. Herring was made from Scotch shale, and known as "blue oil," specific gravity said to be .874, which corresponds to 31° of Baume's scale. A series of careful tests made gave, as average results, the following: Oil weighing 7.28 lbs. per gallon produced 81.85 cubic feet of 65.77-candle power gas. This gas, when compressed as in the Pintsch system, lost 7.10 per cent. in bulk, and was reduced to 48-candle power. It should be here stated that the above yields are based on the American gallon of 231 cubic inches and not on the Imperial gallon of 277.274 cubic inches. In connection with that statement the writer would remind the reader, who may not always remember the fact that, as we hear of remarkable results from water gas apparatus on the other side, it may be well to inquire *what kind of gallon* entered into such calculations before passing judgment upon the performance. It may be fair to assume that American petroleum, or even Russian distillate oil of about the same specific gravity as the shale oil used by Mr. Herring, is a better gas producing medium; for, in carefully conducted tests, the former produced 71.64 cubic feet of 66.66-candle power gas, and the latter 81.64 cubic feet of 49.50-candle power gas per gallon; but when similar oil was carbonized in a nearly new plant of the Pintsch type and on a large working scale, the results were of course not as good as with the experimental plant.

At the Pintsch works referred to, which was then operated under the writer's general supervision, a now well-known and prominently situated gas engineer reported the following general results: Crude oil weighing about 7 pounds per gallon produced 63.16 cubic feet of 56.20-candle power gas, which, when compressed, lost 11.9 per cent. in bulk; but the loss of illuminating power was not found because we did not possess the means to test it after compression. Results from an older Pintsch plant sent to us for comparison were not as good as ours by several per cent.

As the reader now has the facts he can decide from his own results if it would pay him to look into this—to the writer's mind, at least—decided improvement for making gas from oil. To the writer it seems plain that the manufacture of water gas also might be greatly cheapened if the oil were gasified in a rational method like that of Mr. Herring, which statement, however, requires this qualifying remark, viz., that such a method of carbureting water gas could only be economically applied where the minimum consumption of gas would warrant the keeping of an oil bench in continuous operation. In such a case a saving of a couple of cents per 1,000 cubic feet of gas might be counted on, and a saving of a couple of cents per thousand is worth considering by even the greatest and wealthiest of gas companies—perhaps? Then those who make a rich water gas, merely to enrich the otherwise cheaper coal gas, may find an advantage in the oil gas method just described. They would certainly find it a sure remedy for naphthaline troubles, besides a saving in oil bills; and, outside of the inclined retort system for making coal gas, there is not another method extant which requires less labor and attention than Herring's apparatus for manufacturing oil gas.

Address of the President (Mr. C. Stafford Ellery), before the Thirty-fourth Annual General Meeting of the Incorporated Gas Institute.

At the thirty-fourth meeting of the Incorporated Gas Institute, held at Bath, England, June 15, 16 and 17, the President (Mr. C. Stafford Ellery) delivered the following inaugural address:

Gentlemen—Within a very few days the commemoration celebrations which will render this year unique in the annals of English history, will be upon us. Without any thought of politics, I feel sure I am but voicing the sentiment of everyone present when I say that, as members of an Institute representing an industry which has made great advances under Her Majesty's beneficent reign, we desire to associate ourselves with all those expressions of joy and gratitude which rise from every loyal heart, that for so long a period Her Majesty has been spared to reign over a prosperous people.

On looking through our records I find that it is just 20 years since the Institute paid a visit to the West of England. In 1877 the fourteenth annual meeting was held in Bristol, and now it is with sincere pleasure we welcome you to our beautiful old city of Bath. I cannot help feeling that the visit implies a compliment to myself; and I assure you, gentlemen, I appreciate very highly the honor you have done me, and will endeavor to the extent of my ability to justify your choice. I rely on the indulgence and co-operation which have been so ungrudgingly extended to previous occupants of this chair, and trust that the meetings will pass on successfully, and the visit prove sufficiently pleasant to induce many to come to Bath again.

We miss faces to-day that were present on the occasion I refer to. In thinking of some whose absence we regret, there comes the hope that ere long it may be found possible to meet together again and present once more a united front in the interests of the gas industry; but others have been removed by the hand of death. During last year eight have passed away, whose names appear in the annual report of the Council. Of these, three were familiar figures at the meetings. Mr. Travers had been a member for some 25 years, and took a deep interest in all the proceedings. He contributed much valuable information, both in written communications and in discussions. Not long before his death he paid me a visit, and I was impressed with his shrewd judgment and careful attention to the details of any matter he happened to have in hand. Mr. McCrae was also a member of long standing. For over 20 years he attended the meetings, and on occasions, only too rare, was heard in the discussions. Cut off in the prime of life, his presence will be missed by many. Mr. David Clarke joined the Association in 1872. He was elected to the Council in 1888, and stood by the Institute in the time of its trouble. For a year or two he broke his habitual silence, as though with a desire to render assistance when most needed; in this proving his sturdy disposition and the strength of his attachment to the Institute. Since the report of the Council was prepared, the name of one other member, and a Past-President, has been added to the mournful list. Mr. Mitchell, of Edinburgh, died suddenly last month, having retired from active service after a very busy and anxious life. One of the most pleasing tributes to his memory is paid by a writer who says, "Mr. Mitchell was always a great favorite with his workmen and staff." I may safely add, and also with his professional brethren.

Turning from the sad side, it is satisfactory to note that the ranks fill up as one and another silently drop out. With the 53 additions made to-day, the membership stands at the gratifying total of 686. It is a matter for congratulation that so large a number of young men are coming into the Institiute. We look to the new members specially for help with papers, and also in the discussions. There can be no doubt but that at the various works represented, much good research work is constantly being carried on, often perhaps in an unobtrusive way and in places not of the first magnitude, yet such that if recorded would add to the value of the proceedings and the usefulness of the Institute. Before passing to more technical subjects, it occurs to me to offer a few remarks on one or two matters of local interest.

To the gas engineer, the topography of Bath will probably suggest questions of pressure regulation in the distributing system. The district is singularly hilly; the highest point suplied with gas being about 650 feet above the works. The initial pressure is regulated by means of seven station governors, each controlling, as far as practicable, a separate district. These leading mains are connected together at convenient points with valves (for equalizing the pressure if occasion for opening them should arise), and are supplemented by a high pressure main which serves for sending gas by day to a storage station some two miles from the works, and by night to the heart of the distributing system. No governor is used on this main; the necessary regulation being effected by those on the leading mains. On the higher ground, district governors for the automatic regulation of the pressure are employed; and in my judgment those constructed with leather diaphragms are most reliable in their action. It is, however, open to question whether any real balance of advantage is gained by introducing differential governors where the levels vary only within moderate limits. I confess to holding somewhat strongly the opinion that, if the pipes are maintained in proper condition, a little extra pressure is a less evil than any complicated system of governors and valves introduced with a single eye to possible leakage. In considering the question of pressure, it is necessary to bear in mind the various purposes to which in these days gas is being applied, and the indifference which unfortunately is displayed as to the size and quality of internal fittings, both by consumers and too frequently their advisers. I feel almost inclined to suggest that in one of the rooms of the Institute a museum should be opened, with specimens of inferior gasfittings and incompetent workmanship. There are few towns but could contribute interesting examples of how not to lay internal fittings. The fact has to be

faced that fires and stoves are often fixed in houses fitted with pipes too small to pass sufficient gas at the pressure which formerly was considered correct. This is a matter, no doubt, which calls for larger control by the company or corporation supplying the gas; but in the meanwhile, if complaints are to be avoided, and gas is to advance in popular favor, it appears a better policy to maintain a slight excess of pressure for the consumer to draw upon than to give the impression of inadequacy when the need for fuel is felt. This applies with equal force where gas is used as a source of power. The effect of irregularity of pressure is not only to irritate the user, but to cause waste of fuel in the gas engine. These considerations seem to lead in the direction of maintaining throughout the day a pressure nearly approximating to that given during the hours of lighting, and introducing governors, not at consumers' meters, but at each point of consumption—in other words, at the burners themselves.

The following statement is interesting as showing the tendency in recent years towards a more even load in the day and night consumption, and affords evidence of the extending use of gas for heating and power purposes. The figures give the quantity of gas sent out hourly during four winter days, and one day in May of this year, stated in percentages for more easy comparison. The day consumption, taking from 7 A.M. to 10 P.M. in the winter, has increased from 20.1 per cent. in 1893 to 25.8 per cent. in 1896, and the evening consumption has been reduced from 70.1 per cent. to 62.5 in the same period; the day consumption in May reaching 46 per cent., reckoning the hours of daylight from 6 A.M. to 8 P.M. The gas consumption on any particular day is, of course, affected by climatic conditions. But taking the figures as they stand, a steady progress in the direction of equalizing the day and night load is apparent; and the extent of the day output appears to justify the policy of maintaining a liberal pressure at the consumers' services, especially since the unaccounted-for gas, taking the average of the four years, does not reach 5 per cent. of the total make.

Hours.	Dec. 23, 1893. Hourly Consump'n of Gas. Per Cent.		Dec. 22, 1894. Hourly Consump'n of Gas. Per Cent.		Dec. 21, 1895. Hourly Consump'n of Gas. Per Cent.		Dec. 23, 1896. Hourly Consump'n of Gas. Per Cent.		May 29, 1897. Hourly Consump'n of Gas. Per Cent.	
6 to 7 A.M...	2.8	2.8	2.7	2.7	3.4	3.4	2.2	2.2	0.8	
7 " 8 " ...	3.9		4.3		3.8		4.1		2.0	
8 " 9 " ...	3.5		3.1		3.6		3.4		2.7	
9 " 10 " ...	1.3		1.7		2.4		2.6		4.1	
10 " 11 " ...	1.1		2.5		2.5		2.2		3.2	
10 " 12 noon .	1.1	20.1	1.4	22.9	2.6	25.3	2.4	25.8	4.3	
12 " 1 P.M...	1.6		2.6		2.9		2.6		6.0	46.1
1 " 2 " ...	2.4		2.2		2.4		2.3		4.4	
2 " 3 " ...	2.4		2.4		2.1		2.7		2.6	
3 " 4 " ...	2.8		2.7		3.0		3.5		1.6	
4 " 5 " ...	7.7		6.4		6.4		6.9		2.7	
5 " 6 " ...	9.8		10.4		9.6		10.3		3.5	
6 " 7 " ...	10.7		10.3		9.6		10.1		3.6	
7 " 8 " ...	10.4		10.0		9.4		9.5		4.6	
8 " 9 " ...	10.3	70.1	9.9	66.9	9.5	63.1	8.7	62.5	10.0	
9 " 10 " ...	9.9		8.9		8.6		7.6		16.1	
10 " 11 " ...	7.3		6.9		6.3		6.0		12.5	
11 " 12 night.	4.0		4.1		3.7		3.4		5.4	
12 " 1 A.M...	2.2		1.8		1.7		2.6		2.3	53.9
1 " 2 " ...	0.8		0.9		1.3		1.4		2.6	
2 " 3 " ...	1.1	7.0	1.5	7.5	0.9	8.2	1.7	9.5	1.5	
3 " 4 " ...	0 9		1.1		0.9		1.3		1.3	
4 " 5 " ...	0.7		1.0		0.9		1.6		1.3	
5 " 6 " ...	1.3		1.2		2.5		0.9		0.9	
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

In this connection, main and service laying call for a word. The serious effect of heavy steam rollers is well known; but in these days of engineering activity, it looks as if the use of motors, of more or less power to crush and vibrate, will become more general. Already traction engines are to be seen on our roads, drawing loads of such magnitude as to suggest fractured mains and displaced services. There is much to be said in favor of the practice (where subways are not available) of laying of mains on each side of the street under the footpath; short services and absence of crushing weights being perhaps the most important. There still remains the consideration of land disturbances. This, no doubt, is of greatest interest in mining districts; but even in Bath we suffer from a landslip of some magnitude. For many years the ground over an area of some considerable extent on the side of one of the hills has been slowly moving towards the river. Buildings had to be taken down because unsafe, and so far as possible all cast iron pipes removed and wrought tubes substituted. The strain exerted may be gauged if I state that recently, on unscrewing a 2-inch service, the ends when liberated sprang apart to the extent of some 3 inches, affording evidence not only of the tension caused by the land movement, but of the quality and elasticity of the pipe. In such cases there seems nothing but frequent inspection to avoid waste of gas. Still these considerations notwithstanding, I throw in my acquiescence with those engineers who say that the day has arrived for qualifying, if not discarding, one of the old Golden Rules for Gas Managers—viz., "Keep down the pressures."

The topographical interest of Bath is not limited to its hills. The river at times obtrudes itself somewhat unpleasantly on the notice of dwellers and workers in the valley. As it is not given to every manager to pass through the stirring experience of having his retort houses twice flooded within the limits of one week, it might not be without interest to place on record a few particulars of what occurred here in 1894. On Tuesday, Nov. 13, in that year, the river Avon, which divides the works into two sections, was found to be rising unusually high. Rain was falling heavily, and during the morning a gang of men were told off to bay back the water which had commenced to insinuate itself at the doorways. This was successful for a time; but physical forces gradually asserted themselves, and small but innumerable "geysers" appeared over the floors and in the ashpans. The men strove for hours to save the fires by bailing. But the flood steadily rising ruthlessly defied all our efforts; and by 5 P.M. the floors were 8 inches under water, and all the furnaces put out. Each coal crusher pit being filled with water, the charging machinery could not be used. Scoops were resorted to; and the men with willing hearts tucked up their trousers to the task. Notwithstanding these somewhat unpromising conditions, the station meters recorded a make of about 1,000,000 cubic feet of gas that day, or a deficiency of only about 700,000 cubic feet. By 6 A.M. on Wednesday the water had so far receded as to render it possible for the firemen to relight the furnaces. To my intense relief the retorts and brickwork appeared to be little the worse for this "water" treatment. All went well until 3 P.M., when a report came that the river was again rising, and before morning the experience of the previous day was repeated, with this difference only, that the second flood rose some 24 inches above the floor level. Charging was now out of the question, even with willing men waiting to do their work. The bottom retorts were half full of water, and nothing remained but to wait and watch the rushing waters, which during the day varied the monotonous vigil by bringing down laden barges, broken from their moorings, and playfully crashing them against the cast iron columns carrying the Company's railway bridge. Apart from bearing away the fender piles, and tearing a hole in a 24-inch wrought iron main suspended to the bridge, no serious harm was done. By 1 A.M. on Friday it was possible to light large fires on the retort house floors, and clear the ashpans. By 4 o'clock all the furnaces were burning, and at 6 A.M. the station meters showed faint signs of life. As a result of hard firing, carefully selecting the coals, and working light charges, some 300,000 cubic feet of gas were made on Friday, which increased to 1,200,000 cubic feet on Saturday. Gas was turned into the district late on Friday night, and the usual pressure put on the city. To complete the picture, it might perhaps be stated that the gasholders became waterlogged on Thursday, and the mains in the lower districts also filled with water, which found ingress through service pipes broken off in cellars where the flood had floated the meters out of position. For two nights Bath experienced the discomfort of being without gas. The electric light was switched on as usual, which somewhat mitigated the calamity; and the "run" on candles cleared out much old stock. It scarcely needs to be added that the manufacturing plant has been reconstructed on a higher level, and the inlet and outlet pipes of the gasholder lengthened. To do this, two wrought iron bonnet pieces were fixed over openings cut in the crown of the holder, into which the lengthening pieces pass when the top lift has for any purpose to be lowered nearly to the resting stones.

Reference to matters of local interest would be incomplete without some allusion to the fact that Bath was one of the first provincial towns to adopt electricity as a means for lighting the public thoroughfares. The electric works erected in 1890 by a private individual were subsequently purchased by a company, and this year passed into the hands of the city authorities at a figure which will return to the shareholders about one-half of the subscribed capital. The company having failed to make the undertaking a financial success, many eyes will be turned with anxious interest to the report of the first year's municipal management. Corporations, of course, enjoy the privilege of subsidizing such works from the rates—a means of income denied to private companies. The introduction of electric lighting does not appear to hinder the progress of gas undertakings. Not only does each means of lighting seem

to have its own peculiar sphere of usefulness, but it is most interesting to note recent developments of private installations by means of gas engines and dynamos. From inquiries made it appears that where the number of lamps is not less than 15, the cost compares favorably with present charges for current from the public supply. It seems strange that the convenience and efficiency of gas engines have not yet been more fully realized by those responsible for public electric lighting installations in this country. In America, with dearer gas, it is found advantageous to use gas engines with the "block" lighting system, under which, as the name suggests, current is supplied from several centers to save the expense of mains and subsequent loss through leakage. I am informed that, using town gas, the direct saving over central station lighting is from 15 to 20 per cent. It may not be out of place to refer to the need for some more stringent method of insuring an observance of the Board of Trade regulations in laying conductors and consumers' wires. According to the "rules and regulations" issued by the Institution of Electrical Engineers, "the chief difficulties which beset the electrical engineer are internal and invisible—they arise from leakage and from bad connections and joints, which lead to waste of energy and the production of heat to a dangerous extent."

An illustration of this danger came under my notice not long since. In a large house of business the electric wire, which had been laid too near the lead gas pipe, fused the pipe and ignited the gas. The flame was seen in time to prevent a fire. This was fortunate for the proprietor and insurance company. The gas escaped on the outlet of the meter, which was fortunate for the gas company. Equally urgent is the necessity for some proper understanding as to the laying of underground conductors, so as to avoid as far as possible the crossing of pipes and services alike in the interests of electric light and gas companies. There is one point in connection with this subject that strikes the observer as somewhat strange, and that is the perfect confidence with which the public accept the sanguine estimates of electrical experts as to the illuminating effect of the lamps. While gas is tested under conditions and with restrictions of the most exacting nature, yet "the fickle beauty" is permitted to flutter on sometimes bright and anon quite dim, and no one thinks of asking, Is the official tester satisfied? Perhaps this may not always be, and some day we shall have the pleasure of knowing accurately what amount of light comes from a 16-candle power incandescent lamp, and what discount has to be allowed on, say, a 1,000 candle power arc light.

Passing to the geology of the district, and quoting the Rev. H. Winwood: "Within an easy day's walk of Bath no less than 13 or 14 formations can be traversed, from the mountain limestone to the alluvial deposits." Of the coal measures, I will simply say that in the Radstock district, which consists of two main divisions—the upper and lower—there are, to quote another authority, "some 14 veins, none exceeding 3 feet in thickness, some no more than 14 inches." In the Bristol district the Parkfield Colliers have four veins of gas coals, the thickness being between 2 and 3 feet; while at the Kingwood Colliery there are worked three veins of steam coal varying from 2 feet to 4 feet 6 inches in thickness. Quoting again the same authority: "The Somerset and Radstock coalfields are richer in fossil plants than any other coalfields in Britain." Many of these may be seen at the local museums. Passing over the various other strata, I ought perhaps to refer to the "great oolite," for which this neighborhood has long been famous. There is a danger to-day of tarnishing its fair fame by the indiscriminate use of inferior material. An inspection of the masonry remaining as a memorial of, not only the constructive ability, but also the selective skill of the ancient Romans, witnesses in a measure and manner to the permanent character of properly selected stone which is not evidenced in some of the more modern structures. By the kindness of the Directors of the Bath stone firms, one of the most interesting quarries from which the stone is worked will be open to inspection on Wednesday, and information may then be obtained, both of scientific and practical value.

The historical associations and ethnological history of Bath can only be mentioned to say that, by the kindness of the various bodies concerned, opportunity will be furnished for visiting the Roman remains, museums and baths. After contemplating these, I recommend the seeker after "perfect ease and health" to make trial of the waters of our healing springs, which for centuries have, by judicious application, both within and without, done much to relieve the distress and lengthen the lives of multitudes suffering from those painful affections of the muscles summed up in the one word "rheumatism."

Turning to considerations less local, the first thought that seeks expression is that, competition notwithstanding, we meet at a time when the gas industry is prospering and progressing. In looking through the "proceedings" of the Institute, there stands out periods of special activity in engineering achievement and scientific discovery. Not to go further back than my personal experience, there was in 1874, as the absorbing topic, the use of concrete in constructing gasholder tanks. Following with more or less intervals of time came—Mechanical stoking; improved methods of purification; gas engines; regenerative furnaces; regenerative burners; inclined retorts.

It is gratifying to note that to-day we are in the midst of a period of special activity. In the manufacture, distribution and combustion of gas, great strides are being made. Before touching on these, I desire to bear testimony afresh to the service rendered to the industry by the science of chemistry. In recent years, our eyes have more than ever been turned in the direction of the laboratory; and the fact must be patent to all that a knowledge of chemistry is becoming increasingly essential in the training of a gas engineer. I venture to think that, not in greater gasholders or altered methods of guiding them—not, in fact, in any engineering feats of economy, however admirable and necessary these may be—but it seems most probable that advances in the near future will come rather from discoveries by chemists and scientists in extracting more gas from the raw material, and effecting greater economy in its use.

The introduction of plant for the production of carbureted water gas takes a large place in the present period of activity. For some seven years oil has been used in conjunction with some suitable carrier as a substitute for coal and cannel in English gas works, and it may now be claimed that the time of probation is passed, and the process established on the firm foundation of economical efficiency. It is a pity perhaps the gas was not introduced under some other name. The tendency is to shorten the title to plain "water gas," which creates prejudice and wrong impressions in the minds of the uninitiated. My attention was first drawn to the question of producing illuminating gas from decomposed steam in the year 1878, when consulted by a syndicate, in the town of Worcester, to report upon a process patented by a Mr. Stephan for converting water or sewage into a "burnable and luminous gas." The process was thus described: "Steam is generated from sewage in a boiler, passed through a retort filled with closely packed metal or perforated discs, thence to a carbureter, consisting of any suitable material, such as bones, chalk saturated with petroleum, coal, sawdust, or creosote, or the residue from the boiler in which the sewage was evaporated."

Writing on the subject at the time, a local paper summed up the matter in the following words: "Mr. Stephan not only apparently solves the gas question, but he also disposes of the sewage difficulty which has engaged the attention of so many scientific minds. Under Mr. Stephan's process, all sewage matter is to be easily disposed of, gas produced free, gratis, for nothing, and yet an immense profit be made." Now, in this process, spite of its errors, there seems to be something akin to the more perfect idea of to-day; and it is but fair to the patentee, who received but little reward for his labors, that so much should be unearthed. Of carbureted water gas as now manufactured, much has been written by those who understand the subject, and, as is not unusual, by some who know but little. After an experience of some 18 months, I have to express a feeling of indebtedness to those engineers who worked out and brought over this system of gas manufacture from the United States. At first its chief advantage was considered to consist in its being an easy and economical enricher of coal gas; and its merits in this direction are too well known to need enlargement. But to-day its field of usefulness is found to be less limited.

The manufacturing capacity of plants already erected, and in course of erection, is said to be equal to a daily make of 83,000,000 cubic feet of gas; and they range from 125,000 cubic feet upwards. Assuming each plant to be operated during 100 days in the year, the output of carbureted water gas would be about 8,300,000,000 cubic feet, or an equivalent of, say, 830,000 tons of coal. The effect of this displacement must be far reaching. The pressure of the demand for cannel coal has already been removed, and now the keen interest with which friends of the industry scan reports of "the situation in the coal trade" begin to be lessened. The substitution of oil for some portion of the coal used should have a steadying effect upon the market, and diminish those convulsions to which it has too frequently been subjected, and further make available certain coals which hitherto have been considered unsuitable for extensive use in gas works, because an inferior gas may now be so economically enriched by means of oil. The economy of space, not only in the erection of the manufacturing plant, but also in storing oil as compared with coal, is noteworthy, especially for those works where ground is limited. Taking 26 gallons of oil as the equivalent of 1 ton of coal, the relation is as 1 to 10, or, put in another way,

the oil equivalent of 1,000 tons of coal will require only 208 square feet of ground if the tank be 20 feet high. The substitution of coke for some portion of the coal needed in gas making is a further advantage. The material is always on the spot, sometimes in inconvenient quantity, and may be used hot from the retorts. Year by year the output has been increasing, at times beyond the limits of demand; and a larger "home" consumption will certainly tend to enhance its value. To a degree perhaps not so great, the extended use of oil gas should assist the market for other residuals, such as tar and liquor. Looked at from the labor point of view, an oil gas plant presents perhaps its brightest side.

A few men physically unfitted for retort house work can here manufacture gas without strain; the only arduous part being in connection with the removal of clinker from the generators once every eight hours. It looks as though the day may come when, by using retorts for coal in the summer, and meeting the heavy winter demand by oil gas, there will be less disparity between the number of hands employed in summer and winter, and the need for reducing the staff in the spring will be removed. The ease with which sudden fluctuations in the consumption of gas can be met by the use of this plant, is a point of the greatest importance. Instead of the bustle to light up retorts to stay the downward course of gasholders in winter, the simple turning of handles now suffices, assuming sufficient steam to be available; while with equal facility can the illuminating power be altered at will. Although the removal of the carbonic acid requires an increased expenditure on lime, it must be noted that the small amount of sulphur in the gas not only lowers the percentage of sulphureted hydrogen, but reduces the other and more troublesome sulphur compounds.

It may be expected that I should say something about the carbonic oxide present in the gas; but, speaking frankly, I see so little practical importance attaching to the question that, beyond remarking that the ordinary precautions necessary with coal gas need to be observed, I have nothing to add, unless it be to record the experience of an American engineer who recently informed me that for a time he had quite an epidemic of "gassing" among his service layers, when at work in the streets. On inquiry it turned out that with characteristic generosity passers-by paid for certain stimulants for the sufferer; and it was only by issuing a notice that any man found gassed would be dismissed the service of the company that this imposition on the public for "free drinks" was stopped.

The "dark" suggestion has been made to me that, in a recent agitation against the introduction of carbureted water gas to a town of some importance, the fear of "consequences" was most felt by gentlemen interested in the coal trade. Now I have too high an opinion of the fortitude of these gentlemen to accept such a suggestion as correct. It has but to be mentioned to show its utter unreasonableness and forever silence such calumny!

An inquiry into the question of the specific gravity of various gases, and actual experiments with lead and iron tubes, also with meters and burners, prove that the pressure needs to be increased in direct proportion to the percentage of oil gas distributed. The figures show, not only that the discharge of water gas is from 18 to 20 per cent. less than coal gas at a given pressure, but that the theoretical discharge with coal gas is not obtained with some tubes freely placed on the market. Experiments made with burners revealed the same difference, and with a 3-light dry meter it was slightly more. The gas used was about 16-candle illuminating power in each case. It appears, therefore, in round figures, that with 25 per cent. of oil gas and 75 per cent. of coal gas, the discharge is less by about 5 per cent., and with a mixture of half-and half by about 10 per cent., than with coal gas only, and that to pass an equal quantity, the pressure must be proportionately increased. One feature of some importance should be here noted as affecting the examination of mixed gases. The greater brilliancy of the smaller flame of carbureted water gas so increases the light passing through the Methven screen and other standards which utilize a portion of the gas flame in place of candles, as to render it useless unless the mixture be definite and constant, and the slot accurately adjusted.

The question of the supply of oil arises; but the tendency appears to be for prices to fall as the demand increases. This no doubt is in some measure due to the improved facilities for importing the oil rendered possible as the market expands sufficiently to justify the necessary outlay. According to accounts from Roumania, petroleum is said to exist there in large quantities, and doubtless supplies will be forthcoming from other centers as the need arises. In this connection it may not be out of place to add that experiments have been made successfully to enrich water gas by means of cannel coal; and the future may have surprises in store with regard to possible modifications in the manner of treating ordinary gas making coals so as to produce a richer gas as a substitute for some portion of the oil.

In figuring the cost of production, it is a task of no small difficulty to assess the money value of what have been well termed the "collateral" advantages of oil gas manufacture; and yet, to give due credit to the process, these items must be taken into account. In comparing with coal gas, local circumstances also very much affect the figures. Speaking with reference to one town, I find it safe to say the cost of producing carbureted water gas is appreciably less than coal gas at present prices of the raw material and bye-products. I look upon this process, however, simply as an auxiliary to the existing method of manufacture; and it must be said that with this "auxiliary" at hand, the routine of the retort house proceeds with a smoothness and comfort previously unknown.

Improvements introduced into retort houses themselves in late years have also largely tended to economy in working, while reducing the physical strain on the worker. Mechanical appliances for breaking, elevating and conveying the coal, machinery for the drawing and charging of retorts, and improved furnaces for consuming the fuel have each contributed to the result. How far the system of inclined retorts may advance in favor it is not easy to-day to tell; but any new system introduced at a time when the labor cost has been reduced to about 4 cents per 1,000 cubic feet made, has a task of no small difficulty if something better is to be shown. The various schemes which from time to time have been suggested for carbonizing tar prove not only the interest of the subject, but the difficulty of once and for all demonstrating the actual value of this product of the destructive distillation of coal. I had hoped the programme of these meetings would have contained a paper with further particulars of the process in use at Widnes. The effect of mixing the tar from the hydraulic mains, and also from the carbureted water gas plant, with the coal as it passes from the stores to the retorts, is to increase the yield of gas. Possibly to some extent this is due to the physical condition of the coal after treatment. The coal contains a considerable percentage of small; and it is found from careful experiment that mixing tar with the dust in the proportion of 3 pints to the cubic foot, the coal occupies a space over 10 per cent. greater than it did before treatment. The particles do not lie so closely together, and consequently the material is in a condition more favorable for the processes of distillation. The increased yield is doubtless also due to the gas producing power of the tar, which may be taken as from 17,000 cubic feet to 20,000 cubic feet per ton. The efficiency of this tar treatment depends in a large measure upon the hygrometrical condition of the coal. Whether the importance of using dry coal for gas making is fully realized, is a question that may well be discussed at some future meeting. A further effect of using tar is to improve the coke, and also to lessen the trouble caused by thick tar forming in the hydraulic mains.

From the consideration of its manufacture, it is an easy transition to discuss improvements in the means for utilizing gas. The presentation of the Birmingham Medal to Dr. von Welsbach marks the sense of the Institute of the signal services rendered the industry by his improvements in the incandescent method of gas lighting. It is only by comparing the amount of light now obtainable from a ton of coal that the true extent of recent advances in means of lighting can be fully realized.

Taking the yield of gas at 10,200 cubic feet per ton of 16 candles, which happens to be the return in this city, the comparison is as follows:

	Candles per Ton of Coal.	
An ordinary common burner with an efficiency of 2 candles per foot of gas consumed	20,400	52,000
The London Argand at 3.2 candles per foot.	32,640	83,200
The Welsbach incandescent at 16 candles per foot	163,200	416,000
The "Denayrouze" at the figure given by Prof. Lewes in 1895—viz., 27 candles per foot	275,400	702,000
To carry the comparison a little further:		
With 16-candle power electric glow lamps, using a gas engine consuming 22 cubic feet per indicated horse power, and estimating 10 lamps per indicated horse power	74,192	189,120
With similar lamps using a steam boiler and engine with a consumption of 3 lbs. of coal per indicated horse power. In this case, however, there are no residuals, such as coke and tar	119,456	

For the sake of making the comparison complete, assume the coke to be converted into carbureted water gas, say, 50 lbs. produces 1,000 cubic feet, the coke available as 9 cwt..... = 20,160 cubic feet.
Less gas from oil used..... = 4,250 "
15,910 "

The figures work out thus:
Gas from coal .... 10,200 "
Gas from coke .... 15,900 "
Or, say, 26,000 cubic feet from each ton of coal.

The second column shows the candle power based on this yield.

I am reminded that the efficiency of the Welsbach burner to a large extent depends on the regulation of the consumption of gas and the adjustment of the air supply; and no doubt it is of the first importance to give this matter attention, if the best results are to be obtained. Equally essential is it to periodically examine and clean the burner, which observation once more accentuates the suggestion that gas authorities need to extend their interest in the supply even to the point of combustion, by undertaking at a fixed charge to maintain the burners in an efficient condition.

For ordinary street lighting, Welsbach burners, with bulbs instead of chimneys, and inclosed in the new lanterns, which are glazed with shaped glass so adjusted as to reflect the light to the roadway and path where most required, produce a striking effect without any increase in the consumption of gas. Various estimates have been given; but it does not seem safe to calculate on less than an average of five mantles for renewals per annum. It is greatly to be desired that further improvements in the direction of durability will be effected. That finality is not reached even in Welsbach burners is shown by Professor Lewes in his experiments with "Denayrouze" burners in 1895. He states that with a consumption of 9 cubic feet as much as 250-candle power is obtained, or over 27 candles per foot. It is a matter of satisfaction that these burners are now being put on the market; and although in the modified form this high duty is not obtained, yet clusters produce an amount of illumination far in advance of anything yet achieved. If the larger mantles can be made sufficiently durable, and chimneys dispensed with, another important step will be taken in the direction of economical public lighting.

Speaking of present activity, mention must be made of the favor with which prepayment meters are received by the public. Putting the consumption at 12,000 cubic feet per meter, the total gas sold in this manner must gratify the most pessimistic. Opinions seem to differ as to what the extra charge per 1,000 cubic feet sold under this system should be. When it is considered that special inspection and collection are necessary; that many houses become void after the pipes are laid in, and the ingoing tenants sometimes decline to use them; that the meters are still far from perfect, and in a few years will probably involve considerable cost for repairs; further, that the maintenance is high, some customers not being quite so careful in putting pennies in as they might be—it does not seem unreasonable to add 20 cents per 1,000 cubic feet where the rent of meter and fittings is included. The popularity of coin meters among one class of consumers appears to point in the direction of a more extended use of the prepayment system. It is a question whether it would not be a wise policy to give every applicant for a supply of gas a choice of both systems. The penny meter is already supplemented by the shilling meter; and this in its turn may be altered for use with coins of a higher value. I would throw out a suggestion here, especially to makers of cooking stoves. That many persons would be glad of some means by which to check waste of fuel is clear to all. A simple contrivance might readily be attached, when desired, to cookers, by means of which the consumption of gas might be limited to any desired daily outlay. A coin meter serves this purpose; but in these forward days something more simple and less costly should be possible. Indeed, it is a fixed idea in my mind that for the ordinary registration of gas, a simpler, smaller and less expensive instrument will yet be devised. I was much struck with some remarks made last September by the President in his address to the National Association of Colliery Managers: "Another reason undoubtedly for the slackness in the coal trade was that the gas companies had in many large centers offered to supply and erect free of cost gas stoves in all buildings within their district. This question is one of the most serious points the coal trade has to fear." This is an interesting testimony to the growing popularity of gaseous fuel. To complete the picture, another report appeared of a case in one of the London Courts. A chimney sweep was summoned by a money lender, who considered himself aggrieved through not receiving his just due. The sweep's plea for mercy was that his trade was ruined by the extended use of gas fires and stoves. Both statements are doubtless founded on fact. The conversion of coal into gaseous fuel in retort houses does tend to check the waste of our rapidly diminishing store of mineral wealth, and at the same time prevent the pollution of the atmosphere by that unburned carbon which, in spite of the evidence referred to, is still too prevalent.

A new development in mechanical traction has been inaugurated during the past year. It is interesting to find the experiment tried at Blackpool has led to the proposal of introducing gas traction into other towns. The news comes from Paris that boats are now propelled by gas engines, and attain a speed of some 7 knots an hour; the gas being supplied from on shore, and stored on board in steel holders under a pressure of 800 pounds. The many developments of methods for utilizing gas for heating purposes lend force to the suggestion that not only is a photometrical test necessary, but that its calorific value will eventually be watched with as much care as its directly illuminating effect. In view of the lecture kindly promised by Professor Lewes, I refrain from further reference to this subject, except to state that experiments so far go to show that the difference in the calorific value of coal and water gas of about 16-candle power does not appear to exceed 5 per cent.: and when mixed, the slight loss must be inappreciable.

Before putting down my pen, I would add a word on the question of Sunday labor. Some months since a circular was addressed to 1,600 gas managers on the important subject of reducing Sunday labor in gas works. The question has been discussed from time to time, and a sympathetic interest manifested by many members; but as one deeply interested in the matter, perhaps it may lead some who yet doubt the possibility of stopping work on Sundays without considerable loss if I say that last year we closed the works—

29 Sundays from 6 A.M. to 10 P.M.
17 " " 6 " 6 "
5 " " 6 " 2 "

only permitting those men to work who are required to put coke in the furnaces or do repairs only possible when the works are stopped. The effect on the retorts may be to some extent detrimental; but the gain to the workmen, in rest and moral tone, more than compensates for the trifling cost of repairs. After stopping all Sunday labor not absolutely necessary, I am really surprised to find how much it is possible to dispense with, and I confidently recommend the experiment to any, if there be such, who have not yet ventured a trial.

I should like to have said something on the labor question, but am conscious of having already transgressed in the matter of time. I will only add that at no period in the history of the industry has it been more necessary to make employment in a gas works as attractive as possible, in order to secure the interested service of the best men. This applies throughout, even up to the highest grades in the service, and cannot be urged with too much insistence in these days of activity and competition.

Municipal Ownership of Electric Light Plants.

[A paper read by Mr. M. J. Francisco, before the National Electric Light Association.]

Is it beneficial to the taxpayers? Is there a valid reason for adopting it, except for political purposes? Is there a single plant that has saved money for the taxpayers, when all the facts are shown?

Advocates of municipal ownership state that lights under this system cost about half the price charged by private companies, but they do not prove it, and never. It is easy to make such claims, but another thing to sustain evidence. It is claimed that the South Norwalk (Conn.) plant is an illustration of what can be done under municipal ownership. The question is whether the reports sent out regarding this plant are sustained by the facts. There are many reasons for believing that they are made for the purpose of bolstering up the enterprise. February 28, 1893, the Lighting Commission reported that they had expended $22,452.97 of the $22,500 appropriated and had on hand $48.03. They claimed that they had not only installed the plant, but had operated it to that date with the money that the city had appropriated for its installation, and in addition they had on hand a stock of working materials and supplies sufficient for months. In this report they credit themselves with paying $1,040.50 for labor. On October 12, 1893, they made another report in which they state that the wages paid between October 13, 1892, and February 28, 1893, were $895, notwithstanding that they claimed in their first report that they had paid $1,040.50 for the same period. In the second report is an item of $412.99 paid an electric com-

pany and charged to construction, but the inventory does not show any new apparatus installed. Why was it necessary to expend $412.99 for reconstruction in the station after running only six months? Did they not burn out an armature and adopt the usual plan of charging to construction? To reduce operating expenses they deducted supplies on hand. If they had used supplies during the year running the lights, whatever amount had been used during that time should be added to the other expenses, but the idea of deducting supplies on hand which had not been charged to that account, or used, in order to make the cost of lights appear less, is certainly an original one with this committee. In the report of February, 1893, they state that the lamps are 1,600-candle power, in one made October, 1893, they say there are 1,400-candle power, while the October, 1896, reports claim they are 1,200-candle power. Which of these reports is correct? In the 1896 report they claim that there was unexpended at the starting up of the plant $2,500, while the February, 1893, report says that that they had $48.03 unexpended. If, as they claimed, they only expended $1,657.46 operating the plant, and had $2,500 on hand when they completed the installation, what was done with the balance of $842.54? A test made by an expert of their boilers disclosed the fact that only 37 per cent. of the heat of the coal was utilized, that is, they were losing 63 per cent. of all the coal burned under their boilers. With their boilers giving an efficiency of only 37 per cent., they pretend that they can furnish lights at about half the price it costs private companies to produce the same light. The Chairman of the Lighting Committee published a statement that the cost of lights under municipal ownership was 20¾ cents per night, while the private company charged for 81 800-candle power lamps, burned on moonlight schedule, 22 cents per night. If burned, as he says, 311 nights, at 22 cents per lamp, for 81 lights, the cost would be $5,542.02 per year. By reference to the City Clerk's report for that year we find that the total amount paid out for lights to the private company was $4,903.72, being a little over 19 cents per night if burned as he claimed. Why in this comparison did he suppress the fact that the private company furnished the 800-candle power lamps from dusk until 1 A.M. during 26 nights each month for 4½ months of the year, and during the remaining 7½ months burned them from dusk until 5 in the morning every night, giving about 80,000 hours of service which he has not shown or credited to the private company in this comparison—a fair sample of the comparison usually made by advocates of municipal ownership. If he had given the facts he would have shown by his own comparison that the price paid the private company was less than it cost the city to produce them in their own plant. This committee state that lamps only cost $58.96, including interest and depreciation. Upon an examination of their business for the year 1896 we find that the operating expenses were $4,382.82; interest at 4 per cent., $900; depreciation at 8 per cent., $1,800; insurance, $150; taxes, $150; total, $7,382.82; being $74.57 per lamp for a 1,200-candle power burning on moonlight schedule.

In the above calculation the following items were not considered as part of the cost of lights: $488.96, which they added to their real estate after a year's use and without any increase in their property; $359.56 increase in value of tools in the same way; $414.24 for station sewer, which was charged to the sewer account of the city, instead of lighting account, and the expense of a new cable under the river to replace one supposed to have been burned out and the cost of which was charged to extension of plant instead of repairs, where it belonged. Neither does it show the $842.54 which has disappeared if their statement in the 1896 report is correct or the costs and attorney's fees in the two suits of about $20,000, which the city has upon its hands over this electric light plant, and which, even if it should win both, are making and will continue to make thousands of dollars expense for the taxpayers. Charging the expenses up to legal, sewer and other departments does not relieve the taxpayers. It simply gives the committee an opportunity for claiming that the lights are cheap.

Detroit, Mich., has been quoted as the model municipal plant of the United States. The first report of the Lighting Committee gives the cost of operating for one year, interest added, at $84.70 per lamp. When depreciation (at 8 per cent.), with insurance and taxes amounting to $27.30 per lamp is added, the cost is $112 per year. This is the record with a new plant and business confined to the central portion of the city. What will it be when the plant is worn and repairs increase and the lines have to be extended to the city's limits, and the political pull which has already shown its hand in the management has time to develop and organize its forces for the next election?

Hamilton, Ohio, had a Mayor who was an advocate of municipal ownership, and in his report he said "he had made an investigation, and in some cases the figures showed that the city could get its lights for nothing, making enough out of the profits on general electric lighting business to provide all the arc lights required free of expense." This Mayor's statement is the visionary and theoretical part of the plan. What does the practical part or real experience show after the plant has been established? In 1894 the city purchased the gas works, costing $100,000. In 1895 they installed an electric light plant costing $100,000. All of this money was raised by issuing bonds of the city. The plan has proved a failure, and to prevent shutting down the plant and leaving the city in darkness they borrowed $6,000 to pay the running expenses. The City Clerk says: "We are deluded in the belief that we have cheap gas and electric lights, but we must add to these luxuries the fact that we have raised the rate of municipal taxation until it has become burdensome. We are taxed to pay the interest on the bonds as well as to provide for their redemption, and we are also taxed for the purpose of lighting the city, which is nothing more than double taxation. While the tax levy is up to the limit it barely pays the interest charges, with no bonds falling due. Hamilton is being devoured whole by its interest charges. During the coming year the interest owing by the city will amount to the sum of $43,035, bonds fa'ling due $48,000, a total of $91,125, or nearly 90 per cent. of the entire revenue of the city." This is the practical application of the system. Do the taxpayers in other cities wish to adopt the plan and place themselves in the same position?

The taxpayers of Springfield, Ill., were beguiled into adopting a plan which they were told could be carried out so that they would have arc lights at a cost of only $60 per year, and at the end of five years would own the entire plant, paid for out of the surplus or profits. After this system had been in operation for 18 months the Mayor employed experts to figure out the profits. In their report to him they say that the plant at that time had cost $99,379, while the lights cost $93.64 per lamp per year. The local company offered to furnish the lights before the city plant was installed for $90 per lamp per year, the city assuming no liability. The agreement provides that when the surplus amounts to as much as the plant cost, the city will be entitled to take the entire plant. There is no assurance that the business will stand still; on the contrary, the contract expressly provides for a constant increase which will indefinitely delay the maturing of the city's option. The contractors can extend the business without limit and the city must furnish the apparatus necessary for the extension. When the plan was adopted the entire cost was not to exceed $60,000, but it already amounts to $99,379. The Mayor's experts advised him that with the long and constant wear and tear to which this class of machinery is subjected, the depreciation was not less than 10 per cent., and that the city should obtain possession as soon as possible, especially as there has already been expended $16,464 for commercial lighting apparatus, and this amount was steadily increasing. Under the city's charter it is prohibited from doing a commercial lighting business, and therefore will have no use for this apparatus, and will have to dispose of it at any price that it can obtain, thus sinking thousands of dollars on this item. They have installed over 100 arc lights in front of stores to be used only Saturday nights, and from which the entire receipts will not pay the interest on the cost of such installation. It being the taxpayers' money, it is not necessary to economize or restrict expenditures. If they make no more extensions and do not increase the expenses it will require over 12 years from the present time to pay for the present cost of plant. Then the taxpayers have invested $99,000 in a plant which has run 14 years, and is an old, worn-out, antiquated affair. Here we have the practical result of the wonderful plan proposed by the advocates of municipal ownership, whereby a city can obtain something for nothing. The city practically furnishes a plant complete, pays for all extensions, all taxes, attorneys' fees, insurance and depreciation, and then agrees to pay $60 per year per lamp to the contractors for running the plant. There are hundreds of private companies who would be glad to contract with cities upon such a basis.

Des Moines, Ia., is being worked on the same plan, and the taxpayers there will have a chance if it is adopted of voting taxes to their hearts' content. An article was published by an advocate of municipal ownership in which the statement was made that the entire cost of an arc light of 2,000 candle power in Swanton, Vt., was only $10 per year. This malicious statement without a particle of proof to sustain it has been promulgated and distributed as a sample of what may be accomplished by a municipality. Upon an examination of their report ending March, 1897, we find that the plant has cost $42,707.00. The operating expenses, interest, insurance, taxes and depreciation (at 5 per cent.) amount to $7,846.18 per year, while the total income was $4,964.71, leaving a balance of $2,881.47 as the cost of 20 arc lights per year, being $144.07 per lamp, using water power. Their indebtedness in 1895 was

$38,866; in 1896, $41,964, and in 1897, $42,767, while repairs in 1895 were $341; in 1896, $591, and in 1897, $732, showing a steady increase of indebtedness as well as repairs. They voted a tax of 0.30 per cent., one half of it to be used in paying the expenses of the electric light plant, and the other half for all the other expenses of the village, including streets, sidewalks, sewers, water, fire department and police. This shows that the electric lights, instead of costing $10 per lamp per year, require one-half of the entire money received by the tax levy. Whenever one of the advocates of municipal ownership finds himself stranded he immediately flies to Glasgow for relief, and usually proclaims that there the profits from municipal ownership pay the entire expenses of the city, and that no taxes are collected. The Lord Provost of Glasgow brands this statement as false. The Glasgow Street Railroad, owned by the city, has a track 5½ miles long and charges 6 cents fare, and pays its conductors and motormen from 85 cents to $1.12 per day of 10 hours. The West End Road in Boston, Mass., managed by a private company, carries passengers 16 miles for 5 cents, and pays its conductors and motormen $2.25 per day of 10 hours, and for 5 cents carries a passenger three times as many miles as Glasgow. Would it not pay some of the labor organizations who are advocating municipal ownership to compare wages paid by the municipal plant and those paid by the private company. Are they advocating the system because they want wages made $1 per day instead of $2.25? If the system of municipal ownership is so profitable and such a saving when compared with the price charged by private companies, why have so many cities abandoned it after a thorough trial and a loss of thousands of dollars?

Why did Xenia, O., sell a plant that cost $35,000 for $10,000, and Gravesend, L. I., sell their plant costing $120,000 for $31,000? At Michigan City one costing $10,000 sold for $2,500. The Moline, Ills., plant cost $15,000 and sold for $8,000. At St. Joseph, Mo., the plant costing $90,000 sold for $60,000. Scores of others have found that they could not produce the lights as cheaply as a private company, and therefore abandoned their plants and made contracts for their lights. The nine municipal plants in Massachusetts have 1,159 customers who take commercial lights; over 200,000 people are taxed to furnish 1,159 of their citizens with the luxury of commercial electric lights. If all the companies doing business in Massachusetts were controlled by municipalities, over 10,000,000 of the citizens would be taxed in order that 2,458 of their number could be given commercial arc lights, while they are all able and should pay a private company for such luxuries. Under municipal ownership, the man who cannot afford an electric light for his own use is taxed to make up the loss caused by furnishing commercial lights for his neighbor at less than cost. In the costs given by managers of municipal plants no record is ever made of accidents or damages paid. Jacksonville, Fla., gave a glowing account of profits, and claimed that they had run the plant for $620 less than a private company charged for the lights. A short time after that statement was published a judgment for $1,500 was entered against the city in favor of a man injured by falling into a hole dug for a lamp pole, which could not be seen on account of the lights furnished by the city plant being out. How much will there be left of the $620 profits after this judgment of $1,500 is paid? Private companies have to guarantee cities against all such accidents when they furnish the lights. They also have to suffer the loss caused by storms, and in St. Louis one storm alone cost the companies over half a million dollars. We are told that politics are never, or hardly ever, generated in a municipal plant. The Massachusetts Legislature gave a hearing recently regarding the Middleboro plant, in which one of the managers was removed so that one of the commissioners could have the office, and it was by this commissioner's own vote that he elected himself as such manager. An ex-member of the board stated to the Legislative Committee that the plant was run more in the interest of politics than in the interest of the town, and that this manager who elected himself had never had any experience in running a plant and knew nothing about electricity. This is one of the plants that the advocates of municipal ownership are advertising as a great success and an immense saving to the taxpayers. The reason why such a man can act as manager is that a municipal plant is run for politics and not for electricity, and therefore no electrician is required. In Jackson, O., they claim that the elections come so often that the manager cannot become acquainted with the work before another election, when his successor is appointed by the winning party. In Grand Haven, Mich., the Board of Aldermen and the Council were involved in a fight simply because one of the Aldermen had a relative who had labored hard during the election, and was given the berth of electrician as a reward. It is under this style of management and business that we are told that it is cheaper and more beneficial to the taxpayer than a contract with a private company for a stated amount and free from all liabilities and contingencies. The city of Grand Rapids, Mich., is being worked in the interest of municipal ownership notwithstanding the city is already burdened with heavy taxes (and 2,500 places are advertised to be sold for taxes); they want to induce the taxpayers to issue bonds for $125,000 to purchase a plant. There are several private companies in the city and sharp competition. An offer was made by one of these companies to duplicate the prices obtained by the municipal plant at Detroit, the private company furnishing all capital and assuming all liability. What can the taxpayers of Grand Rapids expect to gain by municipal ownership when they can avail themselves of such an offer?—a chance to secure lights at the same price as it costs Detroit to produce them in what every advocate of municipal ownership claims is the model plant of the United States? One of the Aldermen claims that the municipal plant in Detroit has saved the city thousands of dollars, yet when the local company in his own city offer to run the lights at the same price it cost the Detroit plant, the city to have no bonds or liability, he rushed into print with a eulogy on municipal ownership of plants without having a particle of practical experience in the business or knowledge of its requirements. He tells the people that they can produce the lights for about half the price offered by the private company. He refers to Lansing, Mich., as a success, but the Mayor of that city, after an actual experience, does not seem to take the same glowing view of the matter. The Mayor says: "The Lansing plant has already cost $106,000, and is far from being worth any such amount." He claims that the city is not selling to private consumers any such quantity or value of light as it charges them for, and in thus doing business the city is really engaged in wholesale larceny. "We cannot hope to sell the plant for anything like its cost." Quite a different view, after actual experience, from the visionary theory of the Alderman from Grand Rapids. This same wild plan was talked when Hamilton, O., was induced to adopt the system, men advocating the investment of thousands of dollars of the public funds in a business of which they have not the least conception of the details or intricacies, and which requires the most careful and skillful management of any in the world. Why did not this Alderman refer to the city of Marquette in his own State? The Mayor of that city published a statement that the profits from the municipal plant were $5,000 a year, and that in a very short time the profits of the plant would pay all the expenses of the city, and no taxes would be levied. It was by means of such bombastic statements that the taxpayers were induced to authorize the increase in plant and dam. The Mayor and two of the Aldermen, unfamiliar with the business, took charge of the construction, and as a result costly and deplorable blunders were made. Thousands of dollars were spent on construction and in experimenting, and carrying out these wild theories, which were all right until put to a test, when the whole affair gave way. Good judges estimate the loss to taxpayers at $50,000—the result of a "pull" and political management of a business enterprise. It is useless for anyone to claim that cities are managed in a businesslike manner, or even honestly at the present time, while you hear the cry from nearly every State between the Atlantic and the Golden Gate for relief from the corruption and mismanagement of municipalities.

Important Questions in the Economic Working of Steam Engines and Boilers.

[A paper read by MR. BRYAN DONKIN, before the Engineering Conference of the British Institution of Civil Engineers.]

The following are some of the chief points which during the last few years have occupied the attention of leading engineers and authorities, both here and on the Continent, with a view of obtaining the most economical working results:

Steam Engines.—Higher pressures of steam, from 150 pounds to 250 pounds are now being used. Efficient steam jacketing, not only on barrels, but especially to all covers of engine cylinders, except in high speed engines, is essential for the best economy. The percentage of the internal surfaces really jacketed to the total surfaces touched by the steam should always be mentioned. The simple statement that a cylinder is steam jacketed is misleading and insufficient.

The clearance volumes and surfaces of cylinders should be reduced as much as possible. The extent of the clearance surface is very important, and it should be as flat and as smooth as possible. A greater number of revolutions per minute and higher piston speeds are now more used than formerly. Moderately superheated steam has long been employed on the Continent, but is coming in favor here very slowly. It greatly reduces condensation by raising the temperature of the cylin-

der walls. Balancing the rotary parts is now more attended to in high speed engines. Steam pipes should be well drained, to prevent water going into the cylinder, and well clothed, including their flanges.

Workmanship is improved, and there is better automatic lubrication to all the external moving parts. To prevent oil passing through the surface condensers into the boilers, the cylinders and pistons are often not oiled at all. Discussion of this most important point is suggested, with results obtained in practice. Greater facilities should be given for taking to pieces and putting together all the various parts of steam engines, and more attention paid to mechanical efficiency, including piston ring friction.

Rotary turbine types of steam engines are little used, but they have lately claimed much attention, and their economy is considerable. The importance of cylinder wall temperatures and their relation to the temperature of the working steam is still not sufficiently appreciated. This is now recognized as the chief cause of condensation. The greater the difference of temperature between the working steam and the cylinder, the greater the condensation.

Entropy diagrams are a most useful form of diagram, showing thermal units, and are now beginning to be used; but they should be more largely adopted. The subject has been ably treated by several good authorities, both English and foreign.

Practical application of steam has also been lately made to road carriages, and especially for tramways. Some 70 to 100 steam tramways, with little engines and boilers placed at the end of the carriages, are now running in France, chiefly with superheated steam, and are doing good work.

Accurate tests on all types of steam engines are very useful and valuable. Steam engine cylinders and covers are generally not sufficiently protected from radiation. A really economical steam feed or donkey pump is a great desideratum; as a rule they are very uneconomical. Some exact experiments have lately been made in France, showing their waste of heat and steam. They should be worked continuously if possible, and not intermittently; not stopped and started too often, leading to great waste of steam. Comparative tests of different types is suggested. Single-acting engines seem to be on the increase for high speeds. The number of expansions has much increased of late years. Multi-cylinder engines, with 20 or 30 expansions, are very economical, and are often used, but this is only admissible where the barrels and covers are thoroughly steam-jacketed, or superheated steam is used, or both.

A greater degree of compression than formerly, as conducing to economy, is desirable, and now often used. For comparison of experimental results of different steam engines using different steam pressures, the terms should be in thermal units. The steam engine efficiency committee reported, quite lately, that for all purposes, it is desirable to state the economy in terms of thermal units per indicated horse power hour, and also, if possible, in thermal units per brake horse power hour, whether for saturated or superheated steam. Steam should not be allowed to escape at exhaust wet, as the loss of heat by evaporation to condenser from the internal walls is enormous.

Steam Boilers.—Boiler efficiency, or the percentage of heat in the fuel, usefully employed in evaporating water, is now generally recognized as the best method of comparing experimental results in various types of steam boilers, with various fuels working under different conditions. The heating value of the fuel should always be given, and can easily be obtained by a fuel calorimeter.

Forced and induced draught are now much more used than formerly, both on land and at sea, with excellent results. More attention is required to improve the combustion on grates, and to regulate the quantity of air admitted, to insure maximum boiler efficiency. The percentage of priming water in steam should be determined, if possible. There are many instruments for this purpose. Suggestions are invited as to the best and most reliable.

Analysis of the gases at the end of the boiler to determine the percentage of CO_2, CO, and O is most important, and can now be made cheaply and easily. No boiler experiments are complete without such gas analysis. The excess or deficiency of air in the exit gases can be calculated from such analysis.

Automatic stoking generally leads to economy, as the grates are usually better covered with fuel, and there is usually less smoke. Steam jets are often used under grates, but frequently they are found to consume a large amount of steam. Smoke is generally a sign of bad combustion. Black smoke is a disgrace to the boiler engineer or owner, and more attention should be paid to the combustion chamber, and to the admission of air in small streams, and in the right places and at the right times.

Water tube boilers have been more used the last 10 years than formerly, particularly those with small water tubes, for very high pressures. Steam superheaters are often attached to the end of boilers, and they are sometimes separately fired.

Feed-water heaters are much more employed, and with advantage, to reduce the temperature of the gases, the heat of which would otherwise be wasted, and go to increase the temperature of the feed-water. A feed-water heater should be considered as a distinct and separate apparatus, quite apart from the boiler. The efficiency of the boiler should be stated separately from that of the economizer. Much more attention should be paid to cleaning the surfaces, both internal and external, of boiler plates and economizer pipes, so as to facilitate the transmission of heat from the gases to the water.

Soot and lime deposits are both very bad conductors of heat. Facility for repairs is very important, especially in water tube boilers at sea. The variations in the endless types of boilers seem to have less effect on the general economic results than a sufficiency of heating surface and good combustion, with the right quantity of air for the fuel used.

Higher furnace temperatures are desirable, but the products of a combustion should not be allowed to escape at too high a temperature, and the best boiler efficiency is generally obtained with an evaporation of from 4 pound to 5 pound of water per square foot of heating surface per hour.

Coal ground very fine is now being used on the Continent for steam boilers, and the combustion is similar to that with gas firing. The powdered coal is burned with, or better without forced draught. Belleville, and other water tube boilers, are now much employed in warships.

It is surprising that automatic stokers are not used at sea, where it would seem that they are most required. Firing by hand on land is troublesome, but at sea, especially in tropical countries, it is exceedingly trying.

Boilers should be much more carefully covered to diminish radiation. A good combustion chamber at the back of the grate for mixing the gases properly with the air and diminishing the smoke is very desirable, but care should be taken that the flames are chilled as little as possible.

Introduction of live steam into boilers seems to produce economy by improving the circulation of the water. Filtration of air through the brickwork and smokebox of land boilers should be carefully avoided. Air should only be admitted where and when it is really wanted, but this is seldom the case.

The writer has lately collected a large number of reliable tests on steam boilers of various types—stationary, marine and locomotive, with heating value of the fuel, analysis of gases, boiler efficiency, temperatures, etc. Generally speaking, internally fired boilers give a higher efficiency than those externally fired. The old and well-known locomotive type, with smoke tubes and induced draught, stands high as a very economical steam generator.

The term "nominal horse power" of boilers should, if possible, be avoided. It is much better to give the total heating surface. A guarantee is often given of boiler efficiency with a given fuel and a given evaporation per square foot of heating surface per hour. The steam produced should be as dry as possible. Better circulation in land boilers is much wanted.

Coal should be purchased, not by weight only, but by the heat it contains. On the Continent it is often bought with a guarantee that it will evaporate a certain quantity of water in a certain boiler.

Desirability of Reporting Results of Steam Engine and Boiler Experiments on a Uniform System.—It is very desirable that all steam engine and boiler results should be tabulated in a uniform manner. There is now much confusion, as experiments are published in various ways and under different headings by different authorities. The writer suggests that a small committee be appointed by the Council of the Institution of Civil Engineers with a view of determining the best set of headings for the detailed statements of results. Such a standard method would be found very useful for a more rapid and accurate comparison of experiments. The proposed form should be as practical and simple as possible.

In the United States boiler experiments are now nearly always published in accordance with the uniform system of headings recommended and adopted by the American Institution of Mechanical Engineers. Any additions can be made by any experimenter at the end of the standard form to suit special requirements.

THE Cincinnati Gas Light and Coke Company has offered to supply the adjoining Borough of Lockland with gas for public account at the rate of $1 per 1,000 cubic feet.

Gas Engines.

[A paper read by MR. W. F. KELLY before the Engineers' Club, Columbus, Ohio.]

Gas engines may be divided into three types :

1. Engines igniting at constant volume, but without previous compression.

2. Engines igniting at constant pressure, with previous compression.

3. Engines igniting at constant volume, with previous compression.

Of these three types the third is the best known and most extensively used, and is generally known as the compression type ; all the principles being embodied in the well known Otto of to-day, requiring four strokes to complete a cycle, or not more than one explosion for every two revolutions in the case of the single acting engine.

The steps of the cycle are :

1. Drawing in the charge of gas and air in such a proportion as to give complete chemical union when ignited.

2. Compression during return stroke up to a pressure as a rule of about 60 pounds per gauge.

3. Ignition at dead point, when pressure instantly rises to about 190 pounds per gauge for the above compression ; also the temperature to about 2,880° F., estimated. The pressure produced by the explosion depends upon the amount of compression as well as the proportions of the mixture. This ignition is immediately followed by the expansion of the gas for the third stroke, the pressure at the end of the stroke falling to about 25 pounds per gauge.

4. Discharge of the burnt gases from the cylinder during the fourth or last stroke, thus completing the cycle in four strokes or two revolutions.

For complete tests made in 1882 on a 6-horse power Otto engine by Dr. R. H. Thurston, the disposition of 100 heat units was found to be as follows :

Work indicated in cylinder	17.0
Heat lost to cylinder walls and carried away by jacket water	52.0
Heat carried away by exhaust gases (temperature 750° F.)	15.5
Heat lost by conduction and radiation	15.5

The actual indicated efficiency was 17 per cent., but with more recent developments the absolute efficiency has been raised to 28 per cent., partially due to increasing the compression.

The most important mechanical features about gas engines are the starting, oiling, igniting and governing devices. In small engines the starting device is not necessary, as they can be readily started by hand, but in the larger units the failure or partial failure of any one of these features usually results in unsatisfactory service. The bearings, shaft, connecting rod, bed plate, etc., are not difficult to construct and can be as readily made as the corresponding parts of steam engines.

The question of lubrication is much more difficult. The temperatures in steam engine cylinders are comparatively low, steam is readily condensed into water and lubrication becomes a very simple matter. In the gas engine the temperature in the cylinder at the moment of explosion is probably not less than 2,500°. The oil is instantly vaporized and a fresh supply must at once be admitted, otherwise there are large friction losses and cylinder and piston are quite likely to be seriously cut or scored. If animal oil is used, carbonaceous matter is likely to accumulate in large quantities and prevent proper lubrication. Nothing but the best grade of oil, especially compounded for gas engine use, will give satisfactory results for internal lubrication. The various bearings not exposed to undue heat are of course lubricated in the usual manner.

Much time and attention have been given by various inventors to a suitable governing device. While the present mechanical device answers very well for mill work, or other work where close regulation is not necessary, for electric work an electro-mechanical governing device seems absolutely necessary. Slight variations in speed by means of a multiplying lever make and break an electric contact, which controls the current flowing through an electro-magnet, which in turn controls the gas admission valve. This device is exceedingly sensitive and governs the engine very closely through a wide range of load.

Many ignition devices have been proposed, but for thoroughly reliable service none, perhaps, is so satisfactory as the hot tube as proposed by Newton in 1855. A number of small engines are operating with an electric spark from a primary battery. While this method has its advantages it likewise has its annoyances ; contact points corrode and require brightening, batteries become exhausted and require renewal, and unless given attention at the proper time stoppages of the engine may result from failure of the battery. Or if the battery is not used a small generator, belted from some portion of the engine, may furnish the current. This is more reliable than the battery, but is an additional machine to be maintained. The heated tube of iron or steel is rapidly oxidized and requires frequent renewal. If of nickeled steel, they are much more durable, much more expensive and very easily broken. A porcelain tube of unglazed earthenware lasts indefinitely, and if carefully handled and kept free from moisture gives very satisfactory results. At Lancaster, O., a tube of this character has been in use nearly eight months with no apparent deterioration. It has never been touched or removed since placed in service, and seems likely to last indefinitely.

It is frequently asked, how do gas engines compare with steam as regards first cost, economy, durability, etc.? Comparing prices obtained from those who deal in both kinds of engines, we would estimate that for the same capacity a gas engine set up in complete running order will cost about 5 per cent. more than a high speed automatic steam engine with boiler, pumps and necessary equipment, also in complete running order. As compared with a medium speed steam engine with throttling governor, the gas engine would cost about 15 per cent. more; extra heavy, large size gas engines of 100-horse power and upward, 50 per cent. more.

Information from those who have replaced steam engines by engines using gas would lead to the conclusion that with natural gas at 20 cents per 1,000 cubic feet, and coal at $1.10 per ton for slack, or $1.50 for pea coal, their gas bills average less than their coal bills had formerly done. As these comparisons, however, are usually made with a steam plant that has seen its best days and which was probably poorly designed in the first place, as against a gas engine of modern construction, the comparison is hardly fair, and it is reasonable to believe that there is no material difference in the cost of the fuel where each plant is strictly up to date. Some manufacturers of gas engines guarantee that their engines will not consume more than 15 cubic feet of gas per indicated horse power per hour.

In cost of attendance the gas engine has a marked advantage. A Columbus manufacturer states that in his work the cost of attendance does not exceed 5 per cent. of that necessary for a steam engine. Outside of a few minutes' time in the morning and at noon required for oiling and starting, a good gas engine needs practically no attention. This alone makes the total cost of power in small units by gas engines not over 25 to 30 per cent. of similar power derived from steam.

The nature of the valve's motions in gas engines is such that cam motions are almost universally employed and these are in theory short lived. The work done by these cams, however, is so light in practice that they usually give but little trouble, and outside of the occasional renewal of the ignition devices, which can be done at small expense, we see no reason why gas engines should be harder to keep up or shorter lived than steam engines.

It seems strange that America, which leads the world in novel, ingenious and useful invention, which has no superior in mechanical design and the application of machinery to the industrial arts, should be so far behind European countries in the application of the gas engine to mechanical uses. Even now the gas engine is a curious and mysterious thing to many intelligent Americans who are familiar with the use of steam. No accurate information is available as to the number of gas engines in use in America. Every large city has a number of them, but their use is exception rather than general. In Columbus, where natural gas is cheap and abundant, an ideal place for the gas engines, their use is quite limited. The aggregate horse power is estimated at about 600, made up of small units ranging from 2 to 40 horse power. Most of them are of intermediate sizes, such as 6, 10, 12 and 15-horse power.

Some idea of the extensive use of this form of motive power abroad may be obtained from the following statements gathered from recent reliable sources. An English engine maker states that his total sales had at the close of 1894 reached 20,000 installations. The engineer of The London Gas Light and Coke Company, states that there were at that time 2,500 gas engines in use in London, and he estimated that the number in use in England was not less than 35,000. J. E. Dowson, an English inventor, and one who has given careful study to the gas engine for a number of years, states that in Great Britain and Ireland the number of engines sold and in use up to the present time represents something like 600,000-horse power, and the gas consumption annually was valued at $5,000,000. In Germany there are said to be not less than 85,000 in use. In Berlin, a city of 1,800,000, it is estimated that there is one gas engine in use to every 1,300 population. In Hanover, Stuttgart and Erfurt, one to every 600. In Saxony, famous for its manufactories, one to every 200. Gas in these various cities costs from 95 cents to $1.30 per 1,000.

The gas engine is not alone adapted to various forms of shop work and light manufacturing, but is now operating, and very successfully, electric lighting plants of no inconsiderable size. In Royan, France, at the Municipal Casino, a splendid pleasure resort on the seashore, with ample grounds, beautifully laid out and brilliantly lighted, there is an electric lighting plant having one 80-horse power and two 40-horse power engines. A recent report shows that it is not only operated very satisfactorily, so far as the character of the service is concerned, but is also very economical and with but small outlay for attendance or repairs. At Calais, France, the lighting station contains two 80-horse power double cylinder gas engines operating in a very satisfactory manner. Perhaps the most notable installation in the world of a gas engine electric lighting station is at Belfast, Ireland. This municipality owns the gas plant as well as the lighting station. It contains four 120-horse power tandem, double acting, two 60-horse power single double acting and two 150-horse power four-cylinder vertical single acting, high speed gas engines. Reports from the engineer in charge show that the service has proven very satisfactory, and as gas is furnished at cost the operation is more economical than any other form of motive power.

A singular application of a gas engine is that of a steel express barge, which plies on the Seine between Paris, Rouen and Havre. This barge is 98½ feet long, 18 feet beam, and has a capacity of 275 tons and is fitted with an 80-horse power gas engine. The gas, which is compressed to a pressure of 1,420 pounds, is contained in steel tubes, about 16½ feet long, 10 inches diameter and 5 16 inch thick. These tubes are 80 in number, and are laid on the deck, partly to avoid occupying valuable cargo room and to be more easily accessible.

The limited number of gas engines in use in America may be chiefly attributed to three causes: The high first cost compared with steam engines, the high price of gas and cheap coal. These conditions are changing rapidly and are much more favorable than they were a few years ago. Coal in many places is dearer, wood is scarce, gas is much cheaper, and gas engines are better and much lower in cost. Formerly there were but one or two firms engaged in the manufacture of gas engines, and those of but small capacity. Now there are in America about 50 manufacturers bidding for work; many of them manufacturing but small units, while others are manufacturing engines as large as 100 horse power, and, if required, are willing to undertake an installation as high as 300-horse power.

The best gas engines now yield a horse power per hour from 16 to 20 cubic feet of gas, depending largely on the quality of the gas and the type of engine. The annoyances and delays experienced by power users with the earlier types of gas engines, together with the high price both of gas and engine, have done much to discourage and retard the use of gas engines in this country. There is in the mind of the power user a distrust, both as to its reliability and economy, and frequent inquiry is made of those who have been so bold as to purchase them as to whether or not they are giving satisfaction, and if in the light of their experience they would purchase another in the event more power was required.

An intelligent gentleman, who wished to obtain information on this point, sent out the following inquiry to a large number of users: Do gas engines as machines do their work well, and are they all right in themselves? All but three said "yes," and that the repairs were reasonable, moderate or low. To the inquiry: Do they as a rule give satisfaction? 96 per cent. answered "yes."

Aside from the steam engine, which has been so long in use, certainly there is no other form of motive power, not excepting the electrical motor, which has been recently introduced to the consideration of power users, that can show so successful a record as this. Dr. John Hopkinson recently called attention to the fact that illuminating gas burned in a gas engine, driving a dynamo, would yield more light than if the gas were burned in the usual way, and there are a number of instances in which the fact has been demonstrated in actual practice.

When gas engines fail to give satisfactory results the failure may generally be ascribed to ignorance or neglect. Gas engine builders make serious blunders and too frequently try to convince the purchaser that they are blameless. On the other hand the purchaser, who, after many doubts and fears, has installed a gas engine, expects results not possible with any other form of motive power. In current phrase, any old place is considered good enough for a gas engine, hence it is put in a damp cellar, a dark corner or a back shed, exposed to dirt and grit, no attention is given to the bearings or oiling or cooling devices, and then some morning he wonders why it doesn't go. He damns the friend who recommended it, as well as the firm who built and installed it. He doesn't know what is the matter with it and thinks it useless to try and find out. He is ignorant of the most elementary principles of its operation and considers it a mysterious, erratic machine that gets tired and stops to rest in a most exasperating and unexpected manner. If it were a steam engine or an electric motor he would consider that it required at least some intelligent attention, and if it failed to work would concede that it might have been neglected, but that there was nothing inherently wrong with the machine. But he thinks any dunderhead can run a gas engine, and if it isn't always ready for duty it is the inherent cussedness of the machine and not the neglect of the attendant. Had the purchaser sufficient knowledge of the machine to recognize its limitations and consider that it should be properly lubricated, that bearings and valves should be in proper adjustment, that as a machine it requires a fair amount of intelligent attention, there would be less cause for complaint and much more satisfactory results.

It must not be assumed, however, that gas engines are without fault, or are not at times apparently erratic in their action. Tight brasses, poor oil, leaky valves, late firing, early firing, late exhaust, cold ignition tubes, variation in gas pressure, sticky governor, insufficient water supply or some one of a dozen other things might derange the working of the engine. All these things, however, are capable of correction and are not properly faults of the engine. When it is considered that the use of a gas engine dispenses with boilers, fire, smoke, ashes, engineer, smokestack, expensive foundations, valuable room, reduces fire risk, reduces insurance, can be installed anywhere, on the top floor or in the basement, is ready for use at a moment's notice, with no loss of fuel in banked fires during the night or at the noon hours, is clean, economical and reliable, it must be conceded that the gas engine has a wide field of usefulness, and a better acquaintance with its merits on the part of power users will witness its adaptation and use in hundreds of places where steam or the electric motor now holds sway.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

Inclined vs. Horizontal Retorts: A Comparison.

BRAZIL, IND., June 24, 1897.

To the Editors AMERICAN GAS LIGHT JOURNAL:

After my remarks on inclined retorts, at the last meeting of the Western Gas Association, I was asked by a number of engineers the pointed, yet practical question, "Would I recommend the erection of inclined retorts in preference to horizontal?" My answer to this question was an emphatic "Yes," which answer was based upon practical results. I hold to the opinion that anything which reduces skilled labor and makes it possible to approach nearer to a mechanically automatic (if I may so term it) retort house, thereby reducing cost of production and simplifying methods, is a boon to humanity. We are all interested in cheaper methods. Dollars and cents in this age of progress count, and a professional engineer cannot afford to ignore anything that will cheapen and make more humane the methods of charging and drawing retorts; and if any apology is required, my only apology is that the adoption of inclined retorts will result in a substantial reduction in the cost of carbonizing coal, and make life for those engaged in the retort house far more pleasant and agreeable than anything in that line attempted before.

Here naturally the question is suggested, "Have inclined retorts always proved a success?" An answer in the negative only proves the exception to the rule, yet I maintain that from henceforth inclined retorts need never prove a failure, in the light of present practical results. I could fill the JOURNAL with a description of difficulties that first beset us in our endeavor to make them a success, and the means whereby such difficulties were overcome; but time will not allow me to do so. However I think it will be interesting to give a few of the major difficulties, and evolve from these the ultimate success of this method of working. Whilst comparisons are odious, yet we must draw comparisons in this case between horizontals, worked with improved stoking machinery, and inclined retorts; but first, a few of the difficulties with which we met. I venture to state that the original plans, whilst embracing, as has been proved since, a practical possibility, were not in themselves practical. The incline suggested and first tried resulted in the lower end of the retort being packed with coal, whilst toward the center a very thin layer resulted, leaving the upper half empty. This, of course, caused the retorts to crack, besides taking double the time to carbonize a charge, so that, measuring the efficiency of a retort by its first cost and the amount of work which could be gotten out of it in a lifetime, proved double the cost of retorts

worked on the horizontal system. Then, again, the settings sank and soon became curved. This naturally cracked the retorts, rendering it necessary in a short time to replace them. The regenerative furnace was most defective and totally unable to equally heat up the retorts in a setting. This caused some of the retorts to become overheated, whilst others in the same bench were scarcely hot enough to carbonize a light charge in double the time; further, the system of erecting inclines back to back, charging from the center and placing the ascension pipe opposite, naturally caused, on account of the great heat, loss from stopped pipes, and pipe jumpers had to be increased and work generally was most unsatisfactory.

It took considerable time and large expenditure of money to determine the incline which, with the aid of a brake on the nose of the charging shoe, enabled one to obtain an even charge with various sizes of coal. The velocity obtained by lump or round coal compared with slack being, as one would naturally expect, considerable, it has been found that an angle of 32° meets all requirements.

To prevent settling, the arch is formed of a series of small stepped rings tied into each other. The front and end buckstaves are made stronger than is usual in building horizontals, on account of the lateral stress. The regenerative furnace is deeper than in the first experiments. The secondary air supply is well heated by the waste gases before entering the combustion chamber, and can be regulated from both sides of the bench, and also to each retort, enabling one to increase or decrease the heat of any particular retort in a bench at will. And whilst it is generally conceded that more gas can be made in inclined retorts than in horizontals, this, of course, depends upon the heat; heavier charges are being worked in inclines than in horizontals, which natuarally would suggest more heat with its corresponding increase of wear and tear, yet it has been found that the life of inclined retorts is as great, and in some cases greater, than horizontals. Comparisons between the two systems is narrowed down to a fine point because in a retort house of the latest pattern the earning in wages, or the saving in cost of carbonizing due to the mechanical contrivances for bringing coal to the charges, is equal in both cases; *i. e.*, in horizontals to the charging machine, in inclined retorts to the portable charging shoots.

Starting from here where is the advantage of inclines over horizontals? The retorts in one system being set on an incline we get greater carbonizing capacity on the same ground space, greater yield per retort length, no skilled labor required, thus giving greater economy and control of labor, saving in permanent buildings, no charging machine to get out of order or breakdown during a charge, thus ensuring constant working.

The advantage and saving effected in horizontals worked with stoking machinery, as compared with hand labor, are not so much due to the machine itself as to the mechanical contrivances for bringing coal to it; for in many cases, hand charging with mechanical conveyance of coal is almost as cheap as with stoking machinery. In fact I believe that at Birmingham, England, with machine drawing and hand charging, the cost of carbonizing is as cheap as with charging and drawing machinery; but in this case they have an elaborate mechanical system of coal and coke conveyance. It will be found in many retort houses where hand charging is in vogue impossible to introduce stoking machinery, the limited floor space not lending itself to this change. In these cases inclines can and have been erected where, if machine stoking had been adopted, a new retort house would have to be reckoned amongst the improvements. It was for this reason that they erected slopers at Middlesbrough, West Hartlepool, Leigh and other places in England. Existing retort houses were too narrow to discuss the advisability of introducing machine stoking, or the ground space for the new retort house was limited, and hence the inclined system was their choice. In every one of these instances cost of carbonizing has been very materially reduced; at Middlesbrough, for instance, from 72 to 36 cents per 1,000 cubic feet; Leigh, from 62 to 32 cents; at the Greenwich works of the South Metropolitan Gas Company, London, from 73.76 to 41.10 cents—a sufficiently wide range to show the practical saving. There are hundreds of retort houses in this country where it would be possible to reduce cost of carbonizing one half or more by the adoption of this system; and where a retort house has become too small, on account of increased sales of gas, its producing capacity can be increased 50 per cent. by adopting the inclined system, thus saving the cost of a new retort house, thereby reducing capital expenditure, and at one sweep, as it were, doubling production, at half cost for carbonizing with the result of cheaper gas and greater dividends.

In conclusion, I wish to correct my remarks on Mr. Egner's paper, at the Cincinnati meeting, respecting the yield. I meant to say 35,000 to 40,000 cubic feet per man per shift of 8 hours; and this with coal that would not yield more than 8,500 to 9,000 cubic feet per ton. Labor was distributed as follows: 63 retorts, 20 feet long, 24 inches by 15 inches in section, D's; three men for charging, elevating coal, etc., four men for drawing, wheeling away coke, etc. The men were not employed half the time. Since then labor has been still further reduced, but not to the extent mentioned by Mr. Egner in the "Comparative Statement of Cost of Gas Made in Sloping and Horizontal Retorts." Five men, working 12 hour shifts, attend to 90 retorts, 15 feet 9 inches long. Naturally the make of gas per man is high; very high. I can corroborate Mr. Egner's statement that, in England at least, the men working the slopers are not as a rule employed more than half the time, and that the statement as to the number of men employed at Brentford is a fair sample of the general working, viz., 7 men to 96 retorts. The following results have been obtained with retorts 20 feet, on the slope, 24 inches by 15 inches section, set 9 in a bench, with 4 hour charges of 896 pounds each, giving a yield, with a fair coal averaging 10,000 cubic feet per ton, of 24,000 cubic feet per retort in 24 hours, and per man, working 8 hour shifts, 109,714 cubic feet. In my opinion these results can easily be accomplished in this country. Of course the quality of the coal carbonized must always be taken into consideration in comparing the make per mouthpiece or per man. All further comparison by me is avoided, as I find that Mr. Egner has given all the necessary data in last week's JOURNAL. Yours truly, DR. MOSS.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE improvements on the plant and distributing systems of the Macon (Ga.) Gas Light and Water Company, to provide for the payment of which construction the proper legal authority has been vested in Receiver Tinsley, will be carried out under the engineering direction of Mr. Arthur E. Boardman.

UP to the 26th of last June, attachments aggregating $105,000 had been filed in the Suffolk county (Mass.) registry of deeds, against the Boston Gas Light Company, in suits to recover damages resulting from the gas explosion at Boylston and Tremont streets, Boston, March 4, 1897.

THE Board of Trustees, of Tonawanda, N. Y., having considered the bid of the Tonawanda Gas Light Company, for the partial lighting of the streets by gas, authorized the Company to maintain 182 lights of the Welsbach type, at the rate of $23 per lamp per annum, a partial moontable system to rule. If the authorities decide to increase the number of lamps at present authorized, by 50 or more, the rate per lamp per annum is to be $22.

THE new holder for the New London (Conn.) Gas and Electric Company is to be located at the corner of Douglass and Water streets.

THE Fort Wayne (Ind.) Electric Company has been awarded the contract for the installation on the works of the Columbus (Miss.) Gas Company of an incandescent electric light plant. The capacity of the dynamos is put at 1,200 16-candle power lamps, and it is specified that the outfit shall be in working order by September 1st.

A CHANGE in the ownership of the Cambridge (Md.) Gas Company was completed June 25th. Mr. Wm. J. Hopkins was elected President, replacing Mr. James G. Clark, resigned. It is said that the new owners will reduce the selling rate and extend the main system.

A CORRESPONDENT forwards the following: "The object of the ordinance handed in by Mr. David Hardy to the City Council of McKeesport, Pa., about a fortnight ago, is to give to the Union Gas Company, of Glassport, Pa., which really bought out the old McKeesport Gas Company, the right to lay mains anywhere in the public streets, and to tear up 1,000 feet of street at a time, so that the work can be done rapidly. The Company is to secure its supply of artificial gas from the bye-product coke plant of the Pittsburg Coke and Gas Company at Glassport. The ordinance prohibits its charging more than $1 per 1,000 cubic feet for gas. The present rate in McKeesport is $1.25. The old main system of the McKeesport Company will be relaid as soon as the franchise is granted. The old Company's franchise granted it a monopoly of the supplying of illuminating gas in McKeesport, and although natural gas has been used for illuminating purposes, it is claimed that the old Company could have stopped that as an in-

fringement of its monopoly had it felt so inclined. There are really three companies interested in the Glassport bye product plant—the United Coke and Chemical Company, which had charge of the construction of the plant and owns it; the Pittsburg Coke and Gas Company which operates the plant, and the Union Gas Company, which will sell the gas. The same interests practically control the three companies. The plant ran full time all through May and June, and at that it is said, was unable to honor all its orders. In the meantime, I might say some people in and around Pittsburgh are not over-enthusiastic respecting the "tri-nervate" Glassport concern.

WE are advised that the parties in interest in the Monroe (Mich.) Gas Light Company, and the Monroe Electric Light and Power Company, have agreed on a basis of consolidation. The base terms of the amalgamation were dictated by the proprietors of the Gas Company.

AT a meeting of the Directors of the Oneida (N. Y.) Gas Light Company, Mr. Patrick Clark, Superintendent of the Company, was elected a Director, to succeed Mr. Henry S. Klock. A semi-annual dividend of 3 per cent. was declared payable from July 1st.

THE Flushing (L. I.) *Journal*, referring to the recent change in ownership of the Flushing Gas Company, says: "The purchasers are a syndicate of capitalists incorporated under the name of the Flushing Gas and Electric Light Company, of which Mr. H. J. Braker is President; B. F. De Freece, Secretary; H. H. Barnes, Treasurer. The Directors for the first year are Messrs. Charles Whitehead, F. J. Witt and B. F. De Freece. The capital stock of the new Company is $300,000. The entire interest of the old Company in the plant, franchises, rights and privileges, was purchased for a sum exceeding $200,000, and the remainder of the capital is to be invested by the new management in improving the plant and service. Mr. Braker, the President of the new Company, speaking to a reporter of the JOURNAL, said: 'We wish it distinctly understood that we have no connection whatever with the Brooklyn Union Gas Company. We shall assume control of the business in Flushing, July 1st, and propose to expend $100,000 in improvements. To be brief, we propose to improve the service and reduce the rates?'"

MR. HENRY BUMM, at one time a prominent member of the body known as the Board of Gas Trustees that dictated the management of the Philadelphia municipal gas works, died at his home in Philadelphia, about a fortnight ago. He was in his 71st year, having been born in the Kensington district of Philadelphia, November 21, 1826.

THE proprietors of the Keene (N. H.) Gas Light Company have determined to go into the business of furnishing electric currents for incandescent lighting and power purposes. The Company has for some time been engaged in electric lighting on arc account.

A CORRESPONDENT writing from Dallas, Tex., under date of June 25th, says: "The Austin Gas Light and Coal Company has announced a further reduction to $1.60 per 1,000 cubic feet in the price of gas for cooking and kindred uses, and it deserves and will have the assistance of the residents in developing this branch of its business. It has been very actively at work in this way for the past few months, and with gratifying results, having placed a number of ranges that are giving satisfaction in every way. A look over the gas rates shows that six years ago the price was $2.25 per 1,000; after a time it was reduced to $1.75, and a discount of 5 per cent. was allowed; now this rate of $1.60, with 5 per cent. off for prompt payment, puts the net figure at $1.52, which is very much more liberal than the average price of gas in the Lone Star State. It is safe, too, to say that even $1.52 per 1,000 is not the bottom rate, for if the residents will, by their freer use of the article thus liberally offered them, encourage the Company, the latter will put the charge well below $1.50."

THE following notification from Mr. C. S. Price, President of the Consumers Gas Company, of Johnstown, Pa., carries its own explanation:

"OFFICE OF CONSUMERS GAS COMPANY,
"JOHNSTOWN, PA., June 26, 1897.

"The Consumers Gas Company, of Johnstown, Pa., has this day acquired by purchase the manufacturing plant, real estate, street main system, office, accounts, contracts and goodwill of the Johnstown Water and Gas Company, and will conduct the business of the manufacture and supply of artificial gas in the city of Johnstown, Pa., and vicinity, with office at 420 Main street, Johnstown, Pa. The Consumers Gas Company assumes all contracts heretofore entered into by the Johnstown Gas Company and now in force, and will comply with the terms of the same until their maturity. By the terms of the sale all accounts and debts due by the Johnstown Gas Company will be assumed and paid by the Consumers Gas Company, and all accounts and debts due the Johnstown Gas Company are assigned to the Consumers Gas Company and are payable at their office, No. 420 Main street, Johnstown, Pa."

MESSRS. ABEL UPHAM, Adelbert Batchelder and Marvin Dean, of Chicago, have asked for the right to construct and operate a gas works in the Chicago suburb known as Harvey City. In consideration of the granting of the necessary franchise, the promoters agree to complete the plant within two years, and to pay 5 per cent. of the net earnings of the Company to the city. They also pledge themselves to supply gas for lighting, fuel and power purposes, at a rate lower than that obtaining in any other city of Illinois excepting Chicago.

THE following inquiry is referred to our readers, in the hope that some one or more of them may be able and disposed to aid Mr. Miller:

THE MILLER SUPPLY COMPANY,
HUNTINGTON, WEST VA., June 28th, 1897.

To the Editors AMERICAN GAS LIGHT JOURNAL: I have been a subscriber to the JOURNAL for some time, and in my study of the fuel gas and bye-product subjects it has been of considerable benefit. Now, I want to find something written on the uses of coal tar. I have Lunge, Arnold, Butterfield, Hornby and several other works, but they do not give what I want. I want to know the practical part of the making of coal tar paint and roofing, and any other commercial uses, where a small factory would be profitable.—Yours truly, J. C. MILLER.

THE New York and Staten Island Electric Company is erecting at Livingston, Staten Island, a new power house of modern construction. The walls of the building are of brick, and the roofs have steel trusses covered with corrugated iron. The roofs are arranged with suitable monitors, with skylights for light and ventilation. On the building is a large wire tower of steel construction. The building has been constructed with the idea of having it absolutely fireproof and arranged in an up-to-date manner. The roof of the engine and dynamo sections of the building is lined underneath the corrugated iron with the Berlin Iron Bridge Company's anti-condensation fireproof roof lining. The Berlin Company also has the contract for furnishing and erecting all the steel framework and covering for the plant.

WE understand that Manager Frank Bruen, of the Tampa (Fla.) Gas Company, has been authorized to make important additions to the generating capacity of the plant, which goes to show that the capitalists who went into the gas works venture at Tampa something over a year ago made no mistake in their forecast.

THE Wilmington (Del.) *News* says that the case in Chancery of the Oxy-Hydrogen Gas Company, of Wilmington, to determine whether it shall be allowed to lay pipes in the streets, will shortly be reopened and argued before Chancellor John R. Nicholson. The case was originally before Chancellor Wolcott, but the Chancellor being the former counsel for the Oxy-Hydrogen Company, a Chancellor *ad litem* was appointed. Mr. Henry C. Johnson, of Dover, was named, and he has been holding the matter under consideration for several years. When the new Constitution went into effect, the office of Chancellor *ad litem* was abolished. Now the case can be brought before Chancellor Nicholson, and it will be brought in a short time. As the Chancellor has never been mixed up in gas matters he can himself hear and determine the case.

THE Commissioners appointed to appraise the value of the plant and rights of the Le Roy (N.Y.) Gas Light Company, which are to be taken over by the authorities for operation on public account, are Messrs. William C. Watson, Wm. T. Mylcrane and Holden T. Miller, all of Batavia, N.Y.

THE proprietors of the projected gas works for Newport News, Va., have filed with the city treasurer (Mr. J. M. Curtis) a certified check for $5,000, to be forfeited in case the Company fails to have its works in operation within six months after the date of the acceptance of the franchise recently granted.

(*Continued on page* 15.)

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(*Continued from page* 14.)

IT is said that the Wheeling (West Va.) Hinge Company will use gas engines for power purposes.

THE expert appointed by City Council of Covington, Ky., to determine whether or not the Covington Gas Light Company was supplying gas to the street lamps and public buildings in accordance with the terms of the existing contract, found that the Company failed in no particular to discharge its obligations under the agreement. He (Mr. Gaussen) declared that the illuminating quality of the gas supplied averaged 24 candles.

THE City Council of Peoria, Ills., has virtually killed the proposition submitted by the Danforth syndicate for the right to operate a gas and electric light plant in Peoria, Ills.

THERE is very little probability that the authorities of Denver, Col., will grant an opposition gas franchise for that city, although the applicants therefor have been most persistent in their pernicious activity. Meanwhile, the business of the Denver Consolidated Gas Company shows solid evidence of most satisfactory expansion. Manager Branch is paying much attention to the development of the use of gas for cooking.

THE contract for the rehabilitation of the generating plant of the Morristown (N.J.) Gas Company has been awarded to the American Gas Company.

The Discovery of Zircons in Tasmania.

The Journal of the Society of Arts, says that among the many valuable discoveries of late in the Colony of Tasmania, one which has created much interest in mining circles has recently been partially developed. It consists of a rare and unique deposit of zircons allied with other gems and rare earths. The gems found in this deposit are chiefly zircons, sapphires and cinnamon rubies. The first-named are found in large quantities, and in every variety of color. Many of them have been cut and polished with very gratifying results, being hard and of good lustre. The United States Consul-General at Melbourne, who has lately been making an investigation into the circumstances of the discovery, says that the specific gravity of the zircon is 4.7, thus being heavier than the diamond, which is 3.75; its hardness, compared with the diamond is 7, the latter being 10. At the same time it is purely incandescent, being unaffected by the most intense heat, thus proving it to be of high commercial value for use in the manufacture of mantles for incandescent lights. It must be understood that the product of the gem, namely, oxide of zirconia, is used for the above purpose, not the gem itself. The composition of the pure zircon is 64 per cent. zirconia, and 36 per cent. silica. Analyses by Dr. W. H. Gaze, of Melbourne, of two samples of zircons from the above-mentioned deposit, give 63 per cent. and 64 per cent. of zirconia, thereby testifying as to the purity of the gem.

The rarer earths, namely, lanthanum, thorium, didymium, niobium, erbium, cerium and chromium are all more or less present. The property which contains this rare deposit has been purchased by a Melbourne syndicate. It comprises an area of 105 acres, and is situated on the northwest coast of Tasmania, about midway between Emu Bay and Circular Head, and is easily accessible by road from either port. A large amount of work has been done in cutting races and forming dams for sluicing purposes, much labor being expended in removing the heavy timber from the creeks. The deposit of zircons is found in the bed and sides of the creeks, covering about a chain in width. From about 9 to 18 inches from the surface a gravelly wash is met with, averaging about 8 inches in depth. This wash contains the zircons and other rare earths or minerals, and rests in a blue clay bed from 1 to 2 feet in thickness; then occurs a sandstone bar. The zircons and bye-products are obtained by sluicing, the best results being secured by grading and concentrating by gravitation.

The Market for Gas Securities.

The market for city gas shares was fairly active during the week, the inquiry for Consolidated having been quite pronounced. The trading done in it was at a steady advance from the figures last quoted, and the opening to-day (Friday) was at 166½ to 167½, with a tendency to further advance in values. The attempts of certain operators to depress the market for Consolidated were not very successful, for all the offerings were readily absorbed. Equitable and Mutual are a trifle lower, while Standard and New York and East River common were notably strong. The Directors of the last named Company have declared a dividend of 3 per cent. on the preferred stock, payable the 22d inst. Brooklyn Union Gas showed great strength, and the street is seemingly of the belief that its earnings are far in excess of the dividend return now being paid. In this belief we are sharers. The bonds are strong, at 112½ to 113.

Chicago gas sold up to the highest figures made in it for some years, and opened to-day at 93¾ to 94. The scheme for legal consolidation there is pretty well underway, and it is to be hoped that the plan will include the absorption of every Company in Cook county.

Bay State has been experiencing another series of ups and downs, going from 15½ last week to 10¾ yesterday (Thursday). To-day it opened at 12 to 12½. Consolidated, of Baltimore, is steadily advancing, and many shrewd investors are quietly picking it up. Newark (N. J.) gas is at the surprisingly high figure of 142 bid, which rapid advance is based on the idea that in the readjustment of the lighting interests of Jersey City the Newark Company will play a most important part.

The Indiana gas group show marked gains, and Columbus (O.) gas is 78 bid, ex-div.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks,
35 WALL ST., NEW YORK CITY.
JULY 5.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	166½	167½
Central	500,000	50	195	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	222	225
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	243	252
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	85	
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	76	77
Preferred	2,000,000	100	110½	111½
Bonds 1st 5's	3,500,000	1,000	112	115
" 1st Con. 5's	1,500,000	..	106	107½
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	110½	111½x
Preferred	5,000,000	100	117	120x
Bonds, 1st Mortgage, 5's	1,500,000	1,000	113	116
Yonkers	299,650	50	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	110½	111
" " Bonds (5's)	15 000,000	1,000	112	13
Bay State	15,000,000	50	12	12½
" Income Bonds	2,000,000	1,000	..	35
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	87	.
2d " " "	3,000,000	1,000	61	..
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	93¾	94
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	104	104¼
Columbus	1,069,000	..	78	80x
1st Mortgage	1,085,000	..	..	96
Consumers. Jersey City	2,000,000	100	78	77
" Bonds	600,000	1,000	101½	103
Cincinnati G. & C. Co.	8,500,000	100	201½	202
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	57⅜	57⅝
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	22	..
" Con. Bonds	4,312,000	..	73½	74
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	81	83
" Bonds	2,000,000	..	92	94

Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	146	150x
" Bonds, 6's	2,650,000	..	104	106
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind	1,000,000	100	82	84
Bonds	1,000,000	1,000	92	94
Louisville	2,570,000	50	.	..
Laclede, St. Louis	7,500,000	100	2 1/8	24 1/2
Preferred	2,500,000	100	80	81
Bonds	9,084,400	1,000	100 1/4	100 1/8
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	142	..
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	53 1/2	54
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87 1/2	90
San Francisco, Cal.	10,000,000	100	94	94 1/2
St. Paul Gas Light Co.	1,500,000	100	79	81
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	71	72
Bonds, 5's	3,556,000	.	98	100
Wilmington, Del.	550,000	50	200	202

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., 813 DREXEL BUILDING, PHILA., June 24, 1897.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable on July 15, 1897, to stockholders of record at the close of business June 30th. Checks will be mailed.

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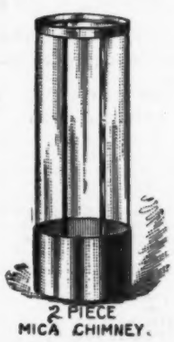

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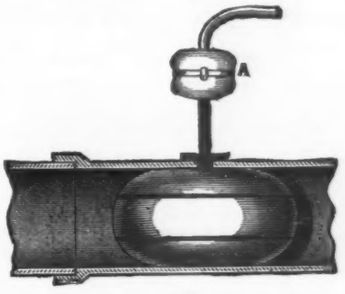

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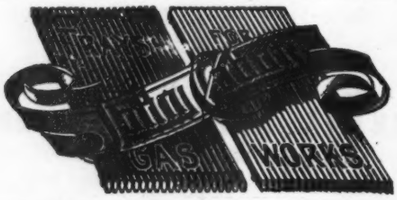

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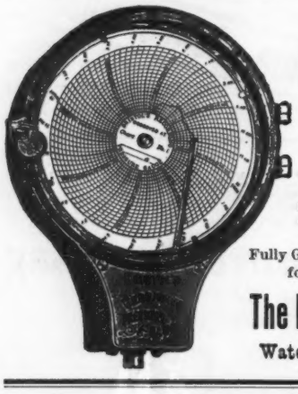

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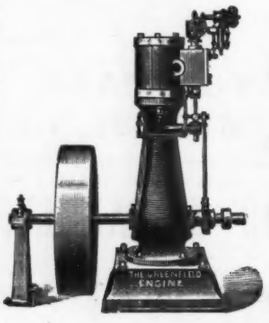

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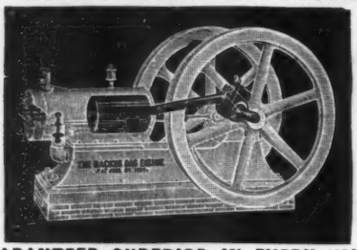

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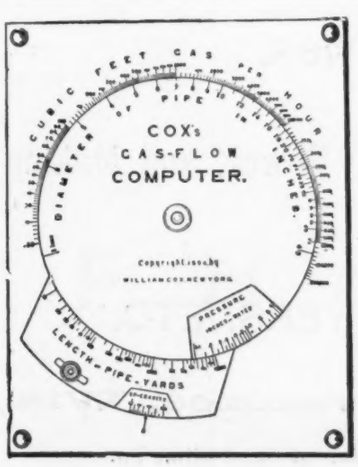

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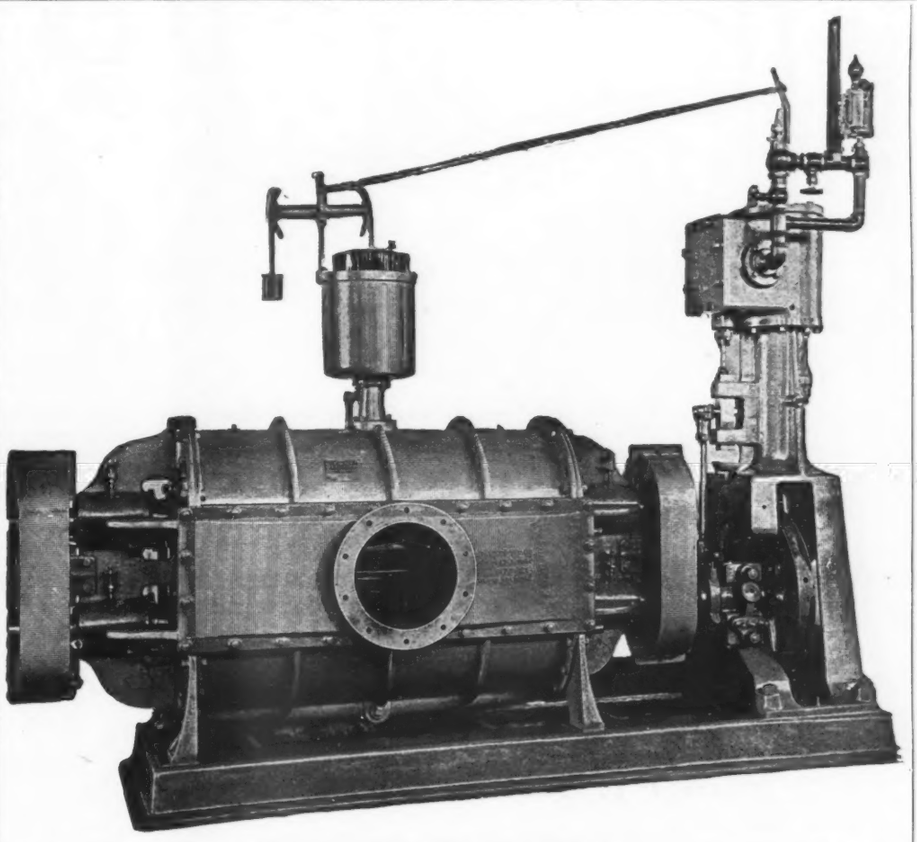

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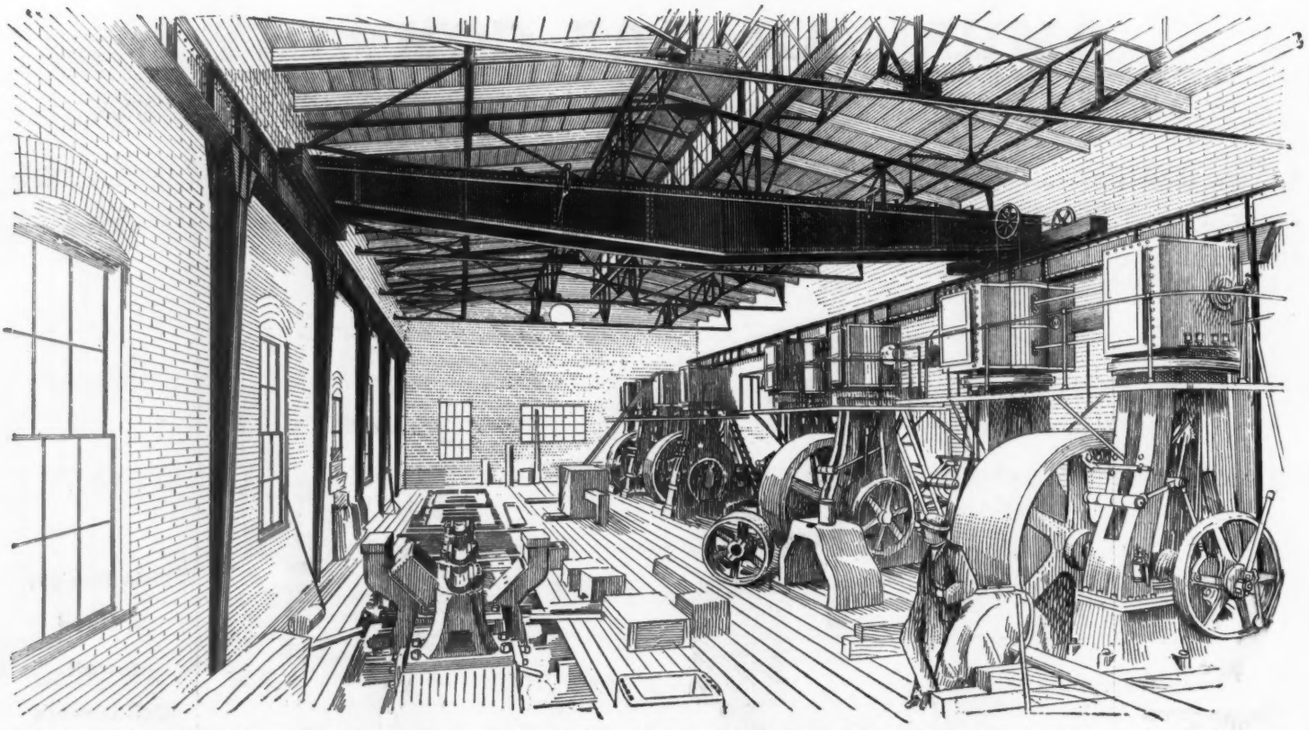

The above illustration is taken direct from a photograph, and shows the interior of a Power House designed and built by us for the Worcester Traction Company, at Worcester, Mass. The building is 47 feet wide and 120 feet long, with a traveling crane as shown. The roof being very flat, it is covered with plank and tar and gravel. The entire frame work is of steel, a light brick wall being placed between the posts to protect the interior of the building from the weather.

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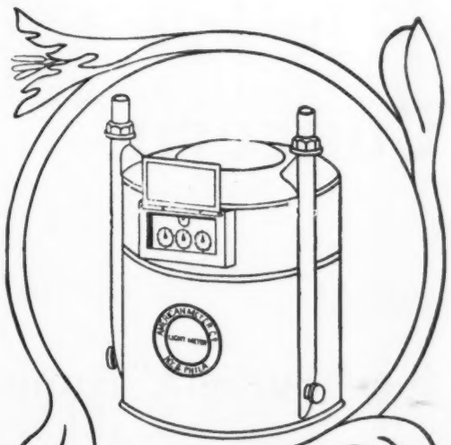

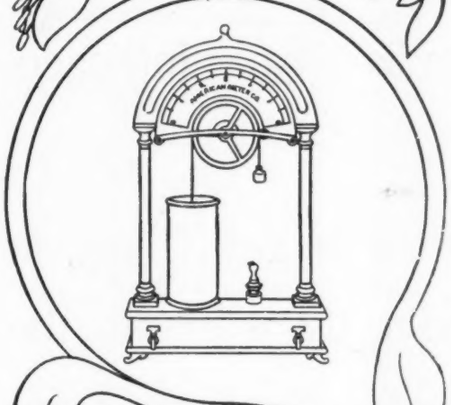

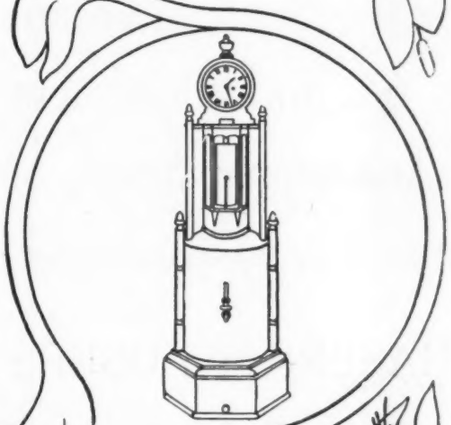

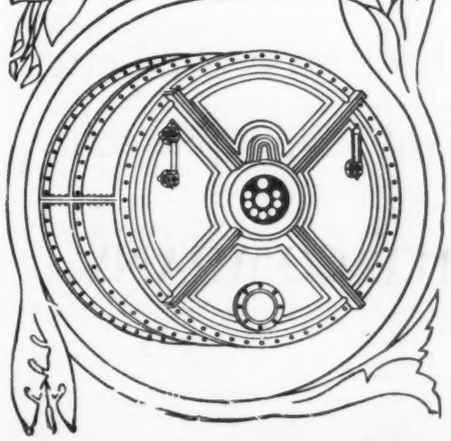

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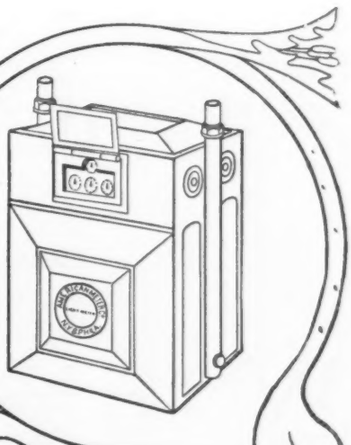
PUBLIC LIGHTING TABLE.

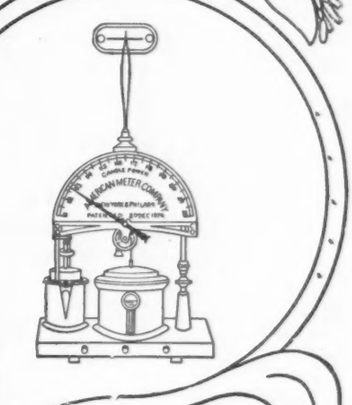
JULY, 1897.

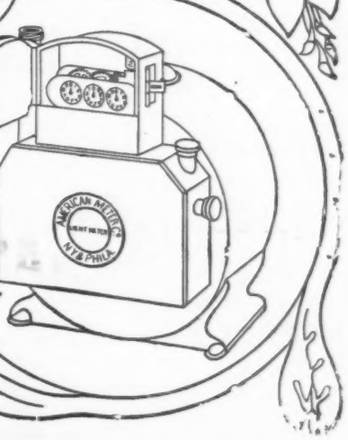
Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguist.
				P.M.	A.M.
Thu.	1	8.00 PM	3.30 AM	7.30	3.15
Fri.	2	8.00	3.30	7.30	3.15
Sat.	3	8.00	3.30	7.30	3.15
Sun.	4	9.10	3.40	7.30	3.15
Mon.	5	9.40	3.40	7.30	3.15
Tue.	6	10.00	3.40	7.30	3.15
Wed.	7	10.30 FQ	3.40	7.30	3.15
Thu.	8	11.00	3.40	7.30	3.15
Fri.	9	11.40	3.40	7.30	3.15
Sat.	10	12.30 AM	3.40	7.30	3.15
Sun.	11	1.30	3.40	7.30	3.15
Mon.	12	No L.	No L.	7.30	3.15
Tue.	13	No L. FM	No L.	7.30	3.15
Wed.	14	No L.	No L.	7.30	3.15
Thu.	15	8.00 PM	9.30 PM	7.30	3.15
Fri.	16	8.00	10.00	7.20	3.15
Sat.	17	8.00	10.30	7.20	3.15
Sun.	18	7.50	10.50	7.20	3.15
Mon.	19	7.50	11.10	7.20	3.15
Tue.	20	7.50	11.30	7.20	3.15
Wed.	21	7.50 LQ	12.00 AM	7.20	3.15
Thu.	22	7.50	12.30	7.20	3.15
Fri.	23	7.50	1.00	7.20	3.15
Sat.	24	7.50	1.50	7.20	3.15
Sun.	25	7.50	2.40	7.20	3.15
Mon.	26	7.50	4 00	7.20	3.15
Tue.	27	7.50	4 00	7.20	3.15
Wed.	28	7.50	4.00	7.20	3.15
Thu.	29	7.50 NM	4.00	7.20	3.15
Fri.	30	7.50	4.00	7.10	3.30
Sat.	31	7.50	4.00	7.10	3.30

TOTAL HOURS LIGHTING DURING 1897.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	233.00	January	423.20
February	187.20	February	355.25
March	202.00	March	355.35
April	170.40	April	298.50
May	163.00	May	264.50
June	140.40	June	234.25
July	151.40	July	243.45
August	167.30	August	280.25
September	174.40	September	321.15
October	200.00	October	374.30
November	205.20	November	401.40
December	220.10	December	433.45
Total, yr.	2216.00	Total, yr.	3987.45







To Whom It May Concern.

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We assure the public there is no decision of any Court, in England or elsewhere, that directly or indirectly warrants the statement or inference that the lamp sold by the Sunlight Incandescent Gas Lamp Company of America is not an infringement of the Welsbach Light as made under the American patents, of which the Welsbach Light Company is sole and exclusive owner.

NOTICE is hereby given to all PURCHASERS and USERS of the so-called "Sunlight" lamp that suits will be brought against them for DAMAGES for INFRINGEMENT of the Letters Patent of the Welsbach Light Company, and will be prosecuted vigorously.

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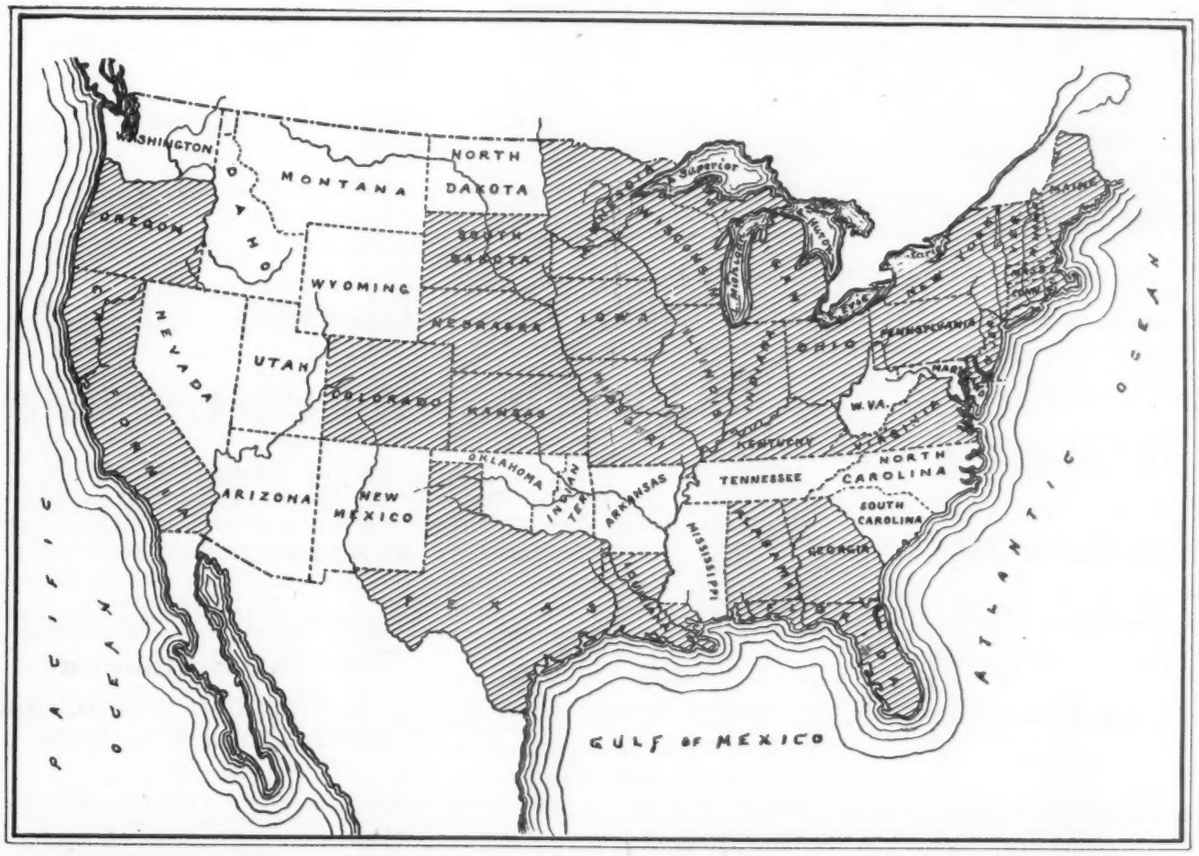

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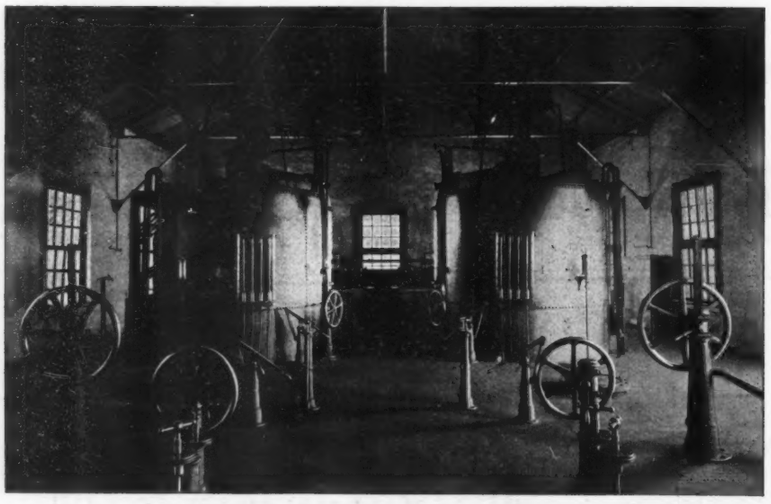

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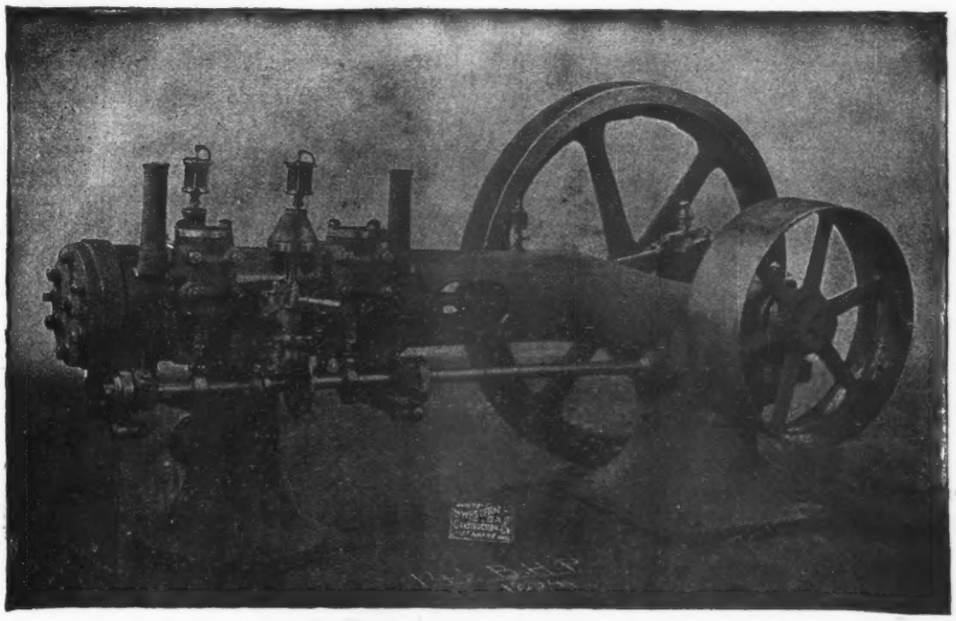

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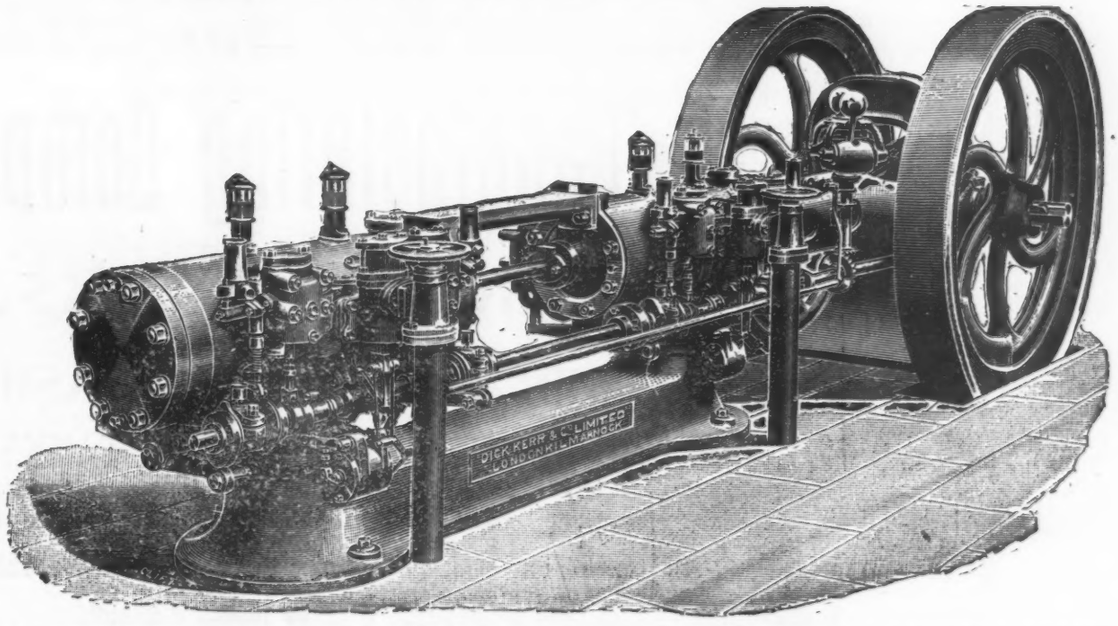

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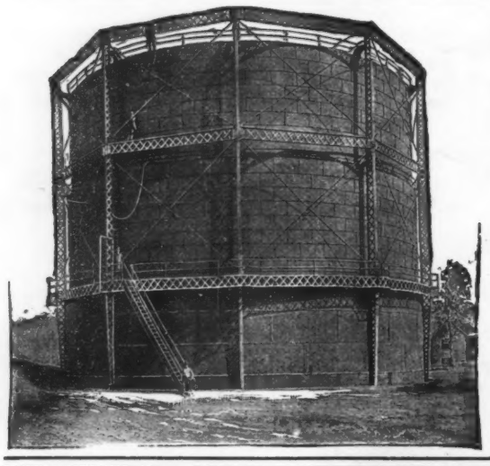

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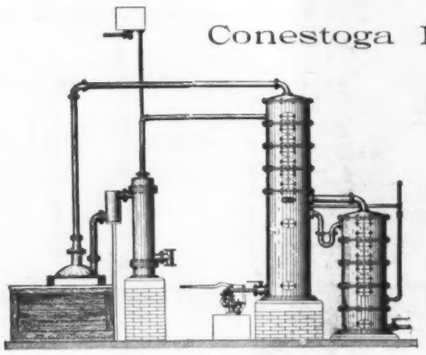

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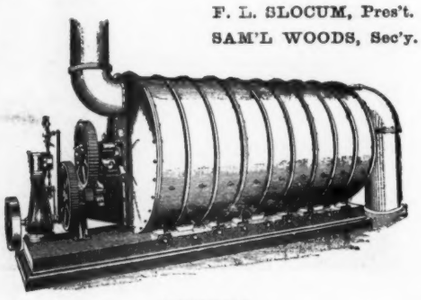

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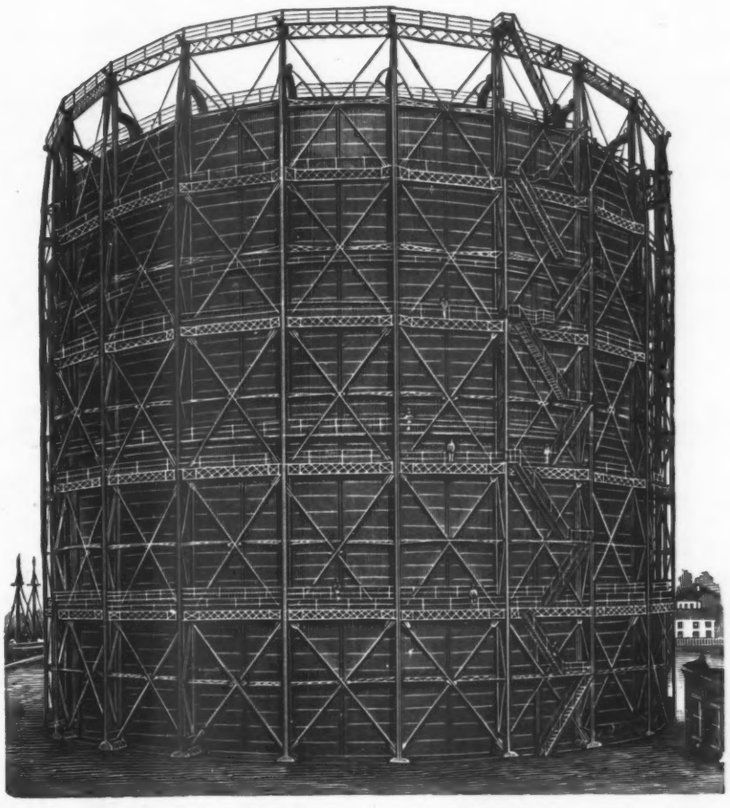

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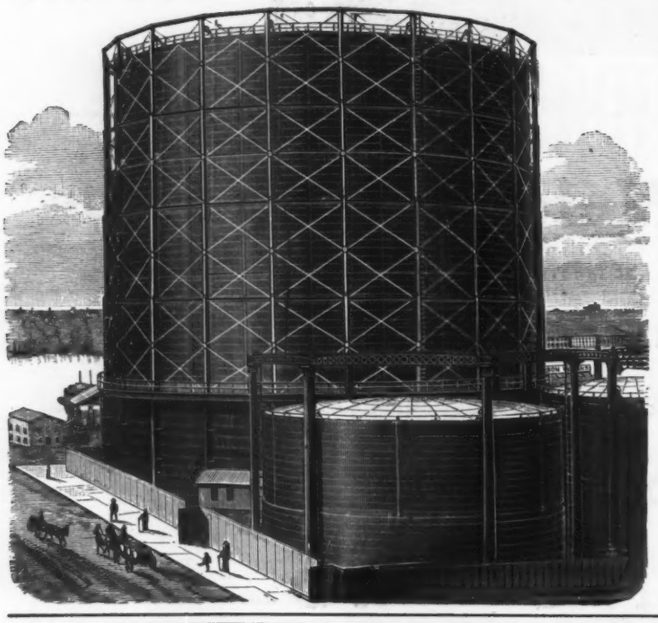

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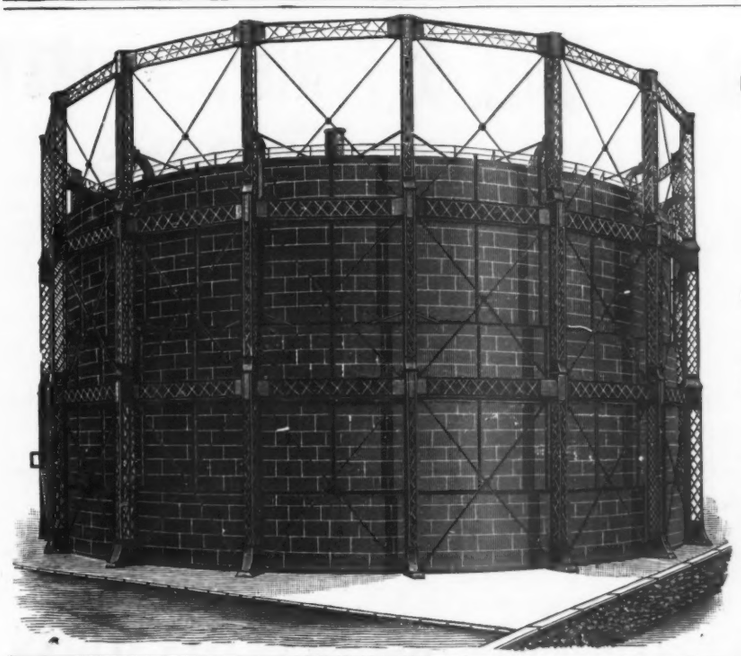

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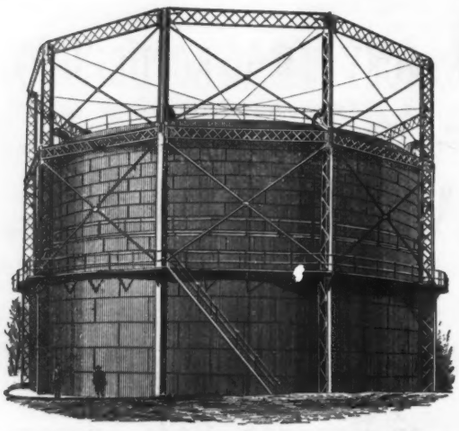

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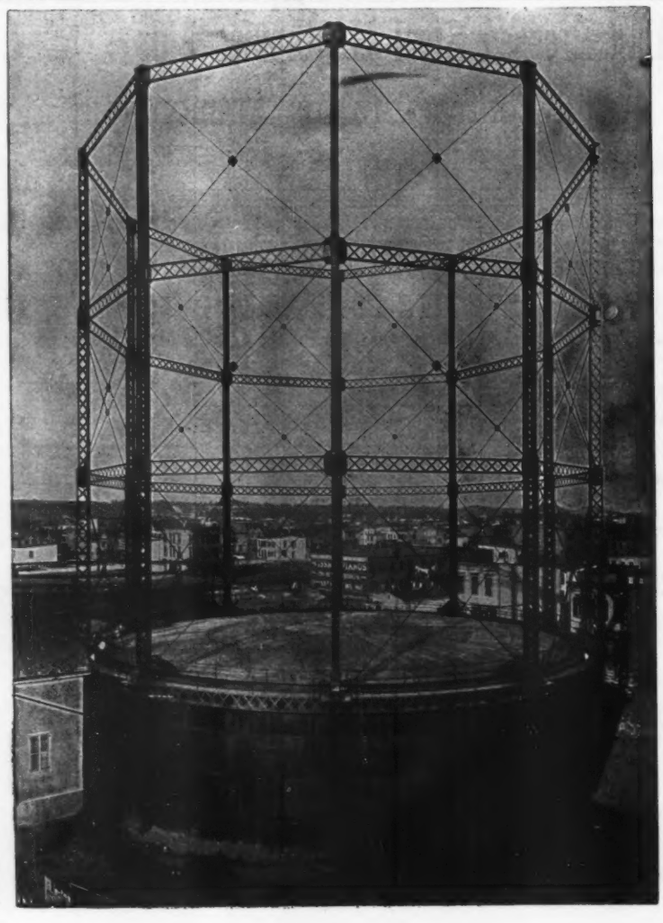

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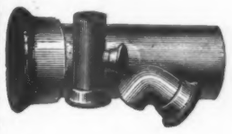

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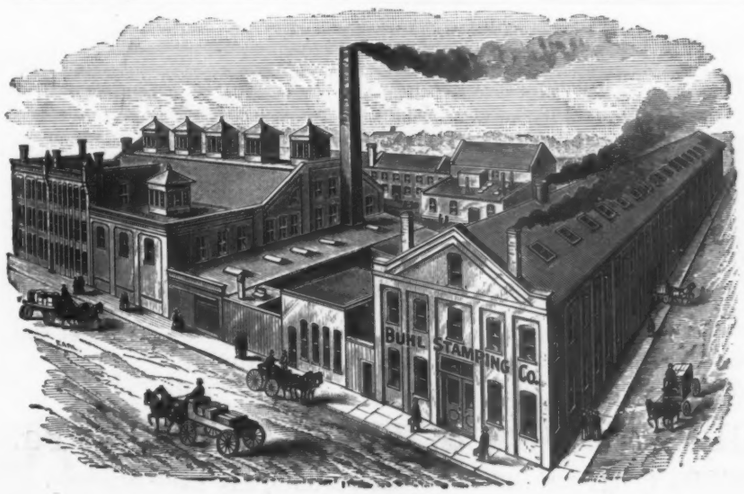

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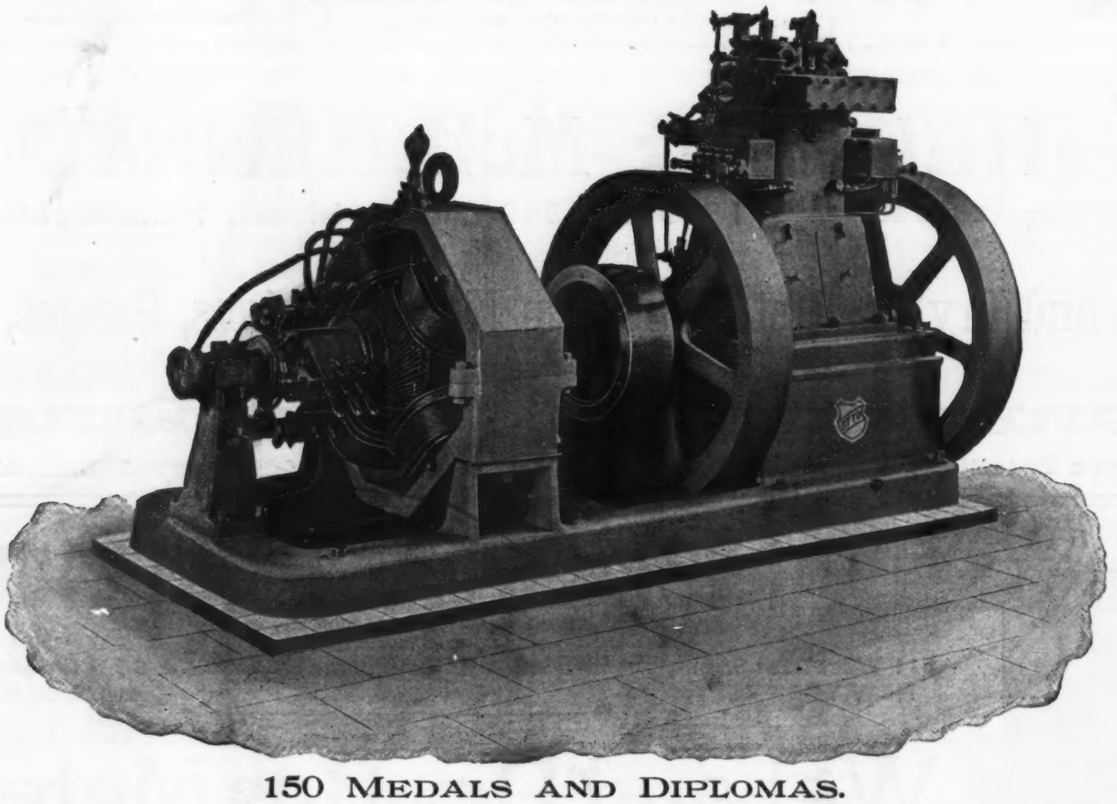

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